Development of a safety system using an embedded traction module controlled by artificial vision

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Abstract

General objective: To develop a Raspberry controlled traction module using image processing through artificial vision, Specific objectives: To generate a communication path between Raspberry and Kinect v2, Develop algorithms for image processing, Develop algorithms for communication between Raspberry and Kinect v2, Methodology: The methodology used in this project is "waterfall", because it is a traditional model that, as its name suggests, is a linear and sequential process: in a very detailed way there is a starting point that would lead to an end point in different stages: Conception, Analysis, Design, Construction, Testing, Implementation and Maintenance.

Introduction

Today, technology has enabled new ways of interacting with digital devices. With the success and mass production of new technologies in digital devices has allowed humans to have at their fingertips and can manipulate them at their convenience. This is the case of the well-known device called Kinect launched by Microsoft for the Xbox 360 console, which is currently being manipulated, not only for game consoles, but also for the development of projects, because it contains infrared sensors and cameras that allow display RGB images and depth, besides having the ability to interpret the movements that are recorded in the objects captured by the vision of Kinect in events that can be projected on screen.

Currently many developers have adapted the device so that it can be used from a computer thanks to the USB port adapter to work with it and give it other uses that were not only for the Microsoft Xbox 360 console. Based on this, in different areas, whether public or private, there is a need for a surveillance system, this to date is mainly limited to traditional systems such as closed-circuit security cameras (CCTV), because of the cost of any additional component. If we add to this the lack of mobility in some of these systems, we will find a large untapped area, which could be improved with a mobile surveillance system so that, in this way, the common blind spots that exist within a CCTV system are considerably reduced. Add to this the possibility of using open source and free to use technologies, such as Raspberry PI, and considerable savings can be achieved compared to a conventional surveillance system, thus making the use of a mobile surveillance system more viable.

Materials and methods

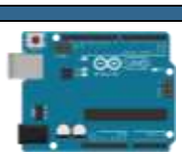
Kinect	
Kinect for Xbox 360, initially known by the codename Project Natal, is a video game peripheral that dispenses with controllers thanks to a motion detection sensor, created by Microsoft and is intended to be usable on computers with the Windows 8 operating system onwards. It is based on a peripheral camera that connects to the Xbox 360 game console, recognizing the player's gestures, face, voice, as well as their movements and static objects within a visual field.	
Processing	
It is a flexible software and language for learning to code within the context of the visual arts. Since 2001, Processing has promoted software literacy within the visual arts and visual literacy within technology. visual literacy within technology. There are tens of thousands of students, artists, designers, researchers and hobbyists who use Processing for visual arts, researchers and hobbyists using Processing for learning and prototyping.	
Java	
It is an object-oriented programming language developed by Sun Microsystems.	
Arduino	
Arduino is a development platform based on a free hardware electronic board that incorporates a reprogrammable microcontroller and a series of female pins incorporates a reprogrammable microcontroller and a series of female pins. These allow connections between the microcontroller and the different sensors and actuators in a very simple way (mainly with jumper cables) very simple way (mainly with jumper wires).	
Raspberry Pi	
Raspberry Pi is a small board computer, single board computer or low-cost single board computer (SBC) developed in the UK. or low-cost single board computer (SBC) developed in the United Kingdom by the Raspberry Pi Foundation by the Raspberry Pi Foundation, with the aim of stimulating computer science education in schools.	

Table 1

Results

1. First phase
- Raspberry PI and drive module

For the realization of the traction module we used a special assemblable body for electronic projects. It has 4 direct current motors operating at 5V. The L298N module was added in a strategic position to have a fast and comfortable access to its terminals.

Figure 1

The L298N module receives signals through its four inputs, through the code developed in IDE Processing using JAVA language. Afterwards, the module was connected directly to the Raspberry PI 3 B+, since the outputs of the Raspberry PI 3 B+ are digital. This module detects when an input is "High" or "Low", activating its outputs with their respective configuration, in this case four GPIO'S were used to control the module: GPIO 1, GPIO 2, GPIO 3 and GPIO 4.

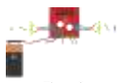


Figure 2

2. Second Phase
Raspbian and Processing

Once the traction module and the other components were mounted, we continued with the installation and configuration of the Processing IDE inside the Raspberry PI, for this we downloaded an .img file from the official page Processing for PI and mounted it in the micro SD memory of the card.

Figure 3

2. Third Phase
Tests with Processing and Kinect

There are different algorithms that were created to work with the Kinect device, developed by different researchers. One of these uses the "Skeleton tracking" technology, in which, different libraries and functions can be observed that allow to interpret some articulations of the body, as well as to section parts of the body, such as right hand, left hand, head, legs, etc. One of the main tasks that were performed was to decompose the code and functions for the understanding of each of its parts, so that, in this way, these could be understood in a simple and effective way for later use, thus, to make decisions depending on what Kinect detected.

Once the algorithm was defragmented and understood, the artificial vision of Kinect v2 was used to make decisions depending on what it was detecting, in this case, the different states of the hand were used so that, by means of conditionals, some outputs of an Arduino Yún were activated, giving rise to endless possibilities for this project, for example, the activation of an alarm if a human being is detected within the area being monitored by the security system, as well as the use of a local network to send an alert to an end device of such intrusion.

Figure 4

Conclusions

The use of a device such as Kinect for other types of areas besides entertainment and leisure is quite broad, not to mention the possibility of using it on an open source platform such as Raspberry. This small advance gives rise to many possibilities, such as, for example, taking screenshots of the image that Kinect gives at the very moment that an intruder is detected in front of its sensors and then send it through a network connection to a final device or store it on a server. All this with the aim of improving the way in which current security systems work, speeding up and making more efficient the collection of data at the moment of a break-in to a guarded area, This is based on the ineffective way of identifying the culprits of the robberies and/or crimes that occur every day in our country through private or public surveillance systems installed in areas that need to be monitored, since these, due to their limited storage capacity, record with a lower resolution so that in this way the evidence can have a longer duration but sacrificing the sharpness of the image.

Several limitations were found in terms of implementation, which are:

- Installing Kinect on "Raspberry PI 3B", since it varies in terms of packages. This could be solved after investigating different uses of this, trying different scripts and using the parts that were useful to reach the goal.
- The Raspberry PI 3B programmable board is not powerful enough to perform the tasks it was designed for, so a hardware upgrade to a newer and/or more capable Raspberry PI programmable board is necessary.
- The load capacity of the implemented motors is very low. They were not able to move the sum of the weight of all the components of the system itself.

Future of research

Future plans include acquiring the hardware required for the system to function as optimally as possible, as well as developing an algorithm to make decisions when detecting a human being within the Kinect's field of vision and creating a communication channel between the system and a local area network to generate an intelligent security system.

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