Flying User Interface

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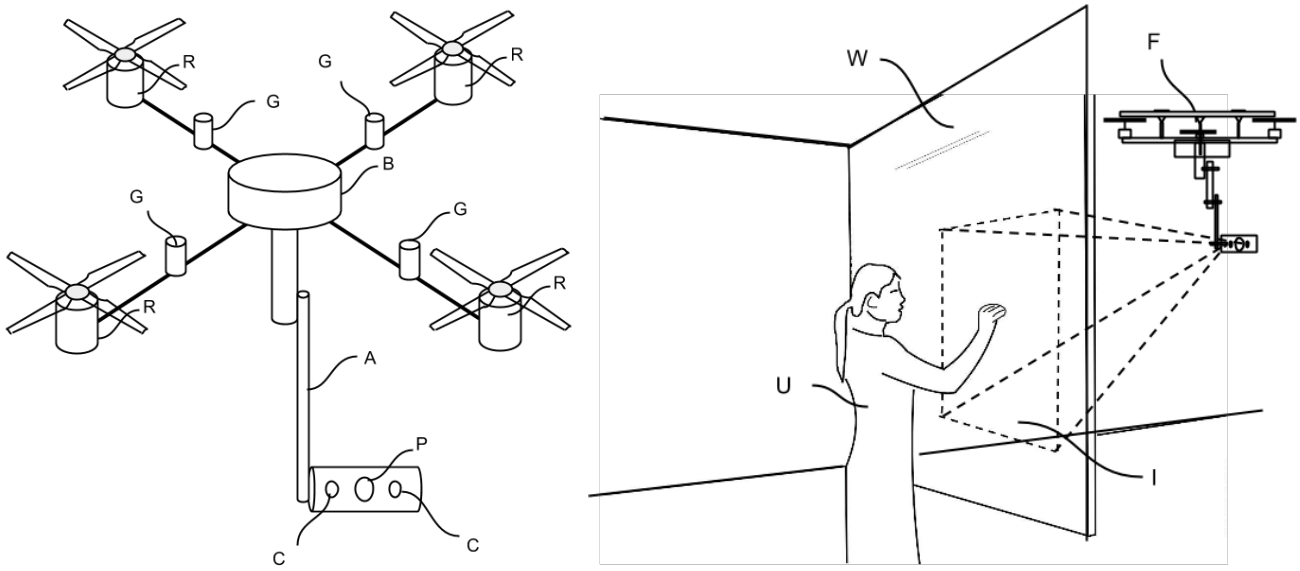

Figure 1. In left picture, Flying User Interface consists of (G) vacuum (or electroadhesion) based gripper, (R) motors for quadcopter, (B) computer, (P) projector, (C) camera, and (A) robotic arm. In right picture, flying user interface (F) is projecting user interface (I) on the glass or semi-transparent wall (W). User (U) is interacting with device using touch or natural gestures.

ABSTRACT

This paper describes a special type of drone called "Flying User Interface"[1], comprised of a robotic projector-camera system, an onboard digital computer connected with the Internet, sensors, and a hardware interface capable of sticking to any surface such as wall, ceilings, etc. Computer further consists of other subsystems, devices, and sensors such as accelerometer, compass, gyroscope, flashlight, etc. Drone flies from one place to another, detects a surface, and attaches itself to it. After a successful attachment, the device stops all its rotators; it then projects or augments images, information, and user interfaces on nearby surfaces and walls. User interface may contain applications, information about object being augmented and information from Internet. User can interact with user-interface using commands and gestures such as hand, body, feet, voice, etc.

[1]Patent Pending

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ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION

Currently available augmented reality devices such as projector camera systems, head-mounted displays, etc. are wearable in nature. Mobile projector camera systems such as SixthSense [2] have various augmented reality applications. Due to their mobility, they support various special projector camera system applications of many types and nature.

One problem with these devices is that they are not fully mobile and the user has to wear them all the time. For example, it is difficult to project a path on the road during running or walking because motion creates an unstable projection image or user interface. In another example we cannot use (or wear) the system during some unusual scenario such as in the shower. In another situation, these devices cannot display or augment information above the user's height without using additional hardware such as rod, etc.

A non-wearable system such as Displaydrone [3] is a projector-equipped drone or multicopter (flying robot) that projects information on the wall, surfaces, and objects in

physical space. Recently researchers also attempted to display information in mid-air using a device called "Flying Display" which consists of two UAVs (Unmanned Aerial Vehicles) with a projector and a display screen. Some mobile robots such as "Keecker" project information on the walls while navigating around the home like a robotic vacuum cleaner. In another example, LUMINAR [1] lamp system consists of a robotic arm and a projector camera system designed to augment projection on a table surface.

One of the common drawbacks in drone based display system is continuous noise during the projection. These drone systems also consume lots of power to stay in the air while displaying projections. Displaydrone and SixthSense approaches each have a common problem of image flicker and unstable projection due to their movement.

FLYING USER INTERFACE

To address above problem, this paper introduces a drone or Unmanned Aerial Vehicle comprised of a robotic arm based projector camera system, an onboard digital computer connected with the Internet and sensors, and a hardware interface capable of sticking itself to any surface such as a wall, ceilings, etc. We call this special type of drone a "Flying User Interface", because it provides real-time augmented reality-based user interface while perched on any surface. A smartphone or any computing device can be used as the onboard computer containing other devices such as accelerometer, gyroscope, compass, flashlight, microphone, speaker, etc.

Drone flies from one place to another, detects a surface, and attaches itself to it. After successful attachment, the device stops all its rotators and begins to project information on surfaces. This mechanism generates a stabilized projection irrespective of the user's motion. The interface is also noiseless, because the drone is now attached to a surface and no longer requires flying to stay in the air. The drone can project clear images and user-interfaces on many nearby surfaces using a projector camera system. For example, when stuck to the ceiling it can project information on the floor and walls. Projector is attached to a small robotic arm that enables projection of information in any direction using two or three degrees of freedom, even on the same surface where device is attached. In some embodiments, if a heavy projector is used, the projector can be attached to the main body or frame of the device, and a robotic arm with the help of mirrors can navigate or change the direction of the projection or projected rays to nearby surfaces. Projected user-interface may contain information about an object being augmented and/or information from Internet. User can interact with the user-interface using gestures from any part of body, such as feet, finger, hand, etc.

APPLICATIONS

This system supports all types of applications supported by previous projector camera systems and drone display systems described in the prior art. For example it can find or detect some hard surface such as paper or plastic sheets, stick to it, and fly with it with a projected user interface.

This system also has its own unique and interesting applications. For example it may stick to a nearby surface and from there augment a user interface application by helping the user learn dancing, games, music, cooking, navigation, etc. It can be used as a display interface for the purpose of advertisement. For example we can deploy these devices in a jungle or garden where these device(s) can hook or stick to rock or tree trunk to provide navigation, especially during the night or evening time. Device can be used with another drone or devices to solve complex problems. For example, multiple devices can be used to create a large display or panoramic view. Or, if we have two devices along both side of a wall, the system can be used to simulate a virtual window by projecting, processing and passing images to each other. The device can be used to project information in difficult situations, such as in the bathroom during the shower, or in the exploration of a dark cave (with simultaneous mapping, visualization, and navigation). More information about possible applications can be found in US patent application [4]. This work is in progress. You can read more information and get updates about the project at `http://flyinginterface.com`.

Figure 2. A Prototype of Flying User Interface device projecting a user interface on a wall using onboard projector camera system. Vacuum based grippers were used to stick to ceiling.

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