projectMove

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The Project

Brief Overview

We've evolved over millions of years to sense the world around us. When we encounter something, someone or some place, we use our five natural senses to perceive information about it; that information helps us make decisions and chose the right actions to take. But arguably the most useful information that can help us make the right decision is not naturally perceivable with our five senses, namely the data, information and knowledge that mankind has accumulated about everything and which is increasingly all available online. Although the miniaturization of computing devices allows us to carry computers in our pockets, keeping us continually connected to the digital world, there is no link between our digital devices and our interactions with the physical world. Information is confined traditionally on paper or digitally on a screen. projectMove bridges this gap, bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures. ‘projectMove’ frees information from its confines by seamlessly integrating it with reality, and thus making the entire world our computer.

Our Philosophy

The idea of creating this device that mobilizes day to day activities sparked from a simple observation. The fact that a person can do all these things with their five senses and make changes using a machine or technology that is stationary ate us alive. So we decided to go ahead and make this technology part of the senses. Yes, it does not look practical to walk around with a physical ‘tech pendant’, however we see that the possibility that this technology creates is outside the reach of a common man. It is indeed, revolutionary.

Project Description

The projectMove prototype is comprised of a pocket projector, a mirror and a camera. The hardware components are coupled in a pendant like mobile wearable device. Both the projector and the camera are connected to the mobile computing device in the user’s pocket. The projector projects visual information enabling surfaces, walls and

physical objects around us to be used as interfaces; while the camera recognizes and tracks user's hand gestures and physical objects using computer-vision based techniques. The software program processes the video stream data captured by the camera and tracks the locations of the colored markers (visual tracking fiducials) at the tip of the user's fingers using simple computer-vision techniques. The movements and arrangements of these fiducials are interpreted into gestures that act as interaction instructions for the projected application interfaces. The maximum number of tracked fingers is only constrained by the number of unique fiducials, thus projectMove also supports multitouch and multi-user interaction.

The projectMove prototype implements several applications that demonstrate the usefulness, viability and flexibility of the system. The map application lets the user navigate a map displayed on a nearby surface using hand gestures, similar to gestures supported by Multi-Touch based systems, letting the user zoom in, zoom out or pan using intuitive hand movements. The drawing application lets the user draw on any surface by tracking the fingertip movements of the user's index finger. projectMove also recognizes user's freehand gestures (postures). For example, the projectMove system implements a gestural camera that takes photos of the scene the user is looking at by detecting the 'framing' gesture. The user can stop by any surface or wall and flick through the photos he/she has taken. projectMove also lets the user draw icons or symbols in the air using the movement of the index finger and recognizes those symbols as interaction instructions. For example, drawing a magnifying glass symbol takes the user to the map application or drawing an '@' symbol lets the user check his mail. The projectMove system also augments physical objects the user is interacting with by projecting more information about these objects projected on them. For example, a newspaper can show live video news or dynamic information can be provided on a regular piece of paper. The gesture of drawing a circle on the user's wrist projects an analog watch.

Hardware

Camera

The camera is the key input device of the projectMove system. The camera acts as a digital eye of the system. It basically captures the scene the user is looking at. The video stream captured by the camera is passed to mobile computing device which does the appropriate computer vision computation. The major functions of the camera can be listed as:

- Captures user's hand movements and gestures (used in reorganization of user gestures)
- Captures the scene in front and objects the user is interacting with (used in object reorganization and tracking)
- Takes a photo of the scene in front when the user performs a 'framing' gesture
- Captures the scene of projected interface (used to correct the alignment, placement and look and feel of the projected interface components)

Projector

The projector is the key output device of the projectMove system. The projector visually augments surfaces, walls and physical objects the user is interacting with by projecting digital information and graphical user interfaces. The mobile computing device provides the projector with the content to be projected. The projector unit used in prototype runs on a rechargeable battery. The major functions of the projector can be listed as:

- Projects graphical user interface of the selected application onto surfaces or walls in front
- Augments the physical objects the user interacting with by projecting just-in-time and related information from the Internet

Mirror

The mirror reflects the projection coming out from the projector and thus helps in projecting onto the desired locations on walls or surfaces. The user manually can change the tilt of the mirror to change the location of the projection. For example in application where the user wants the projection to go on the ground instead of the surface in front, they can change the tilt of the mirror to change the projection. Thus, the mirror in projectMove helps in overcoming the limitation of the limited projection space of the projector.

Microphone

The microphone is an optional component of the projectMove. It is required when using a paper as a computing interface. When the user wants to use a sheet of paper as an interactive surface, he or she clips the microphone to the paper. The microphone attached this way captures the sound signals of users touching the paper. This data is passed to the computing device for processing. Then, it is combined with the tracking information about user's finger. The system is able to identify precise touch events on the paper. Lastly, the sound signal captured by the microphone provides time information whereas the camera performs tracking. The sound and visual data that has been processed can then be applied to various apps which carry out their respective functions (mailing app, clock app, car racing game app etc). Theoretically speaking, using the defined parameters, we could play a car racing game on a sheet of paper (the sheet being our computing device while the projector being our source of visual data).

Mobile Computing Device (Any windows device)

The projectMove system uses a mobile computing device in user's pocket as the processing device. The software program enabling all the features of the system runs on this computing device. This device can be a mobile phone or a small laptop computer. The camera, the projector and the microphone are connected to this device using wired or wireless connection. The detail of the software program that runs on this device is provided in next section. The mobile computing device is also connected to the Internet via 3G network or wireless connection.

Representation

Figure 1.0 to the right describes a representation of how all the components will come together. They can be put together either using lego strips or velcro.

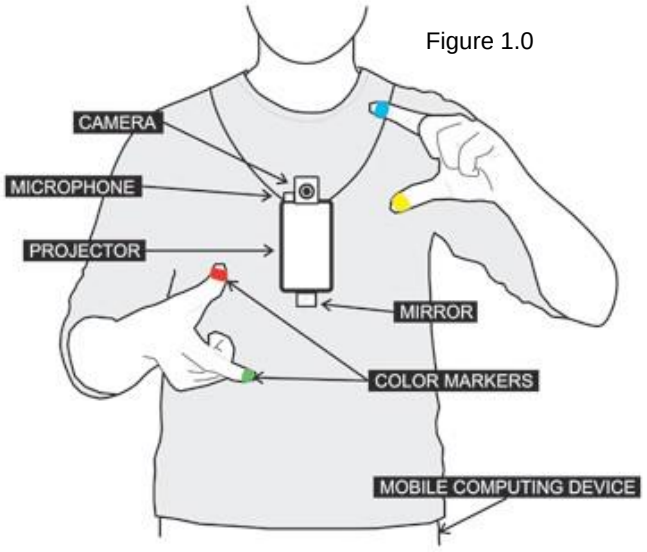

Figure 1.0

Software

Implementation of Code

The prototype system runs on windows platform and majority of the code is written in C++ and C#.

Beta Code

WYW_v1.0 is the beta version of projectMove code (WYW stands for Wear Your World). This version runs on Windows. The code is operated with the aid of Visual Studio and Direct X.

Camera: We choose which camera to use and configure the camera settings here. We may need to mirror the camera here using the camera settings. We also use fixed/ manual white balance and exposure such that the camera image is stable and light independent.

Tokens: This version of code uses colored fingertips as markers. We need 4 different colors in order to run most of the Apps. We chose to use Red, Yellow, Blue and Green (or colors that are variant on the color spectrum). We have also speculated that the matt colored tape/objects work better as they have less reflective changes. Once we have all four markers (O, P, M, and N) added the software will start tracking the four markers. We can set the thresholds to better the tracking. We can save those markers and can reuse in subsequent executions, or can add new markers every time.

Apps: Apps tab allows us to choose the apps we want to load and run. One can also load apps from ‘Menu’. ‘Menu’ is triggered using ‘Namaste’ gesture. Once on Menu screen we can choose the App by hand-click (Hand Click gesture works by moving the O marker and hiding P marker).

Conclusions

Conclusively, we see that projectMove is a creation that embarks into an aspect of technology not quite visited by traditional engineers. As growing engineers, we see that associating the physical world with the technology that we develop allows mankind to enhance at unimaginable levels. This development is a ‘slap in the face’ to critics of technology and engineering that go on to say, “the new generation is glued to their devices, they have lost the understanding of the world around them.” In response, projectMove addresses the very concern by infusing the world around us with technological advancements that bring the union of nature and technology to allow people to explore avenues like never before.

We strongly believe that projectMove has the potential to become a revolutionary technological advancement and it certainly deserves the support of the respective departments as this is not only a project by a few students for a class, it is a development that could possibly drive the foreseeable future virtually enhanced technology.