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Raspberry Pi Selfie Cam

I. Introduction

Selfies quickly grew from a thing of gym rats to a popular trend. It started mostly with teens and rapidly expanded throughout the world, until the famous, aged, and even the very young joined the mix. Devices have even been invented to make the taking of a selfie easier and more adaptable, most notably the selfie stick. There are several versions of the selfie stick, but they share a common tactic: by employing the volume key of a smartphone, either via the headphones port or by Bluetooth, they can activate the shutter function of any camera app. There are other devices that use this same technique, such as remote shutter buttons that allow for taking pictures from a distance.

The problem with the selfie stick and selfies in general is simple: you have to hold your phone. Which of course isn't a major problem, unless you want either to pose or don't want the camera in a mirror picture. Or perhaps you want a picture from a distance. No matter the case, these problems and especially the matter of camera shakiness plague selfie-takers to the point where some people can spend upwards of five or ten minutes just trying to take the right picture. I'm confident that anyone who likes to take pictures of themselves, either to see their progress or for self esteem purposes, or simply for showing off - or even just sending selfies, attractive or ugly, to friends and family - has dealt with these… problems.

II. Problem Characterization

My project was aimed at a solution to all of these issues. Sure, they're not "problems" per se, but they are certainly minor annoyances for someone like me who spends part of every day in the gym and wants to keep track of his progress. By using the Raspberry Pi, I wanted to

create a prototype of a selfie camera, a small camera which could clip to one's shirt or stick to a surface and, via Bluetooth, relate the image its camera was seeing to a phone. The phone then could be used to frame the shot and with a timer (or the hand being in the pocket or something), take a picture without the phone being visible. This would work great in front of mirrors, essentially giving you the ability to look however you want while taking your own picture, without the limitations of selfies as they are. One purpose of this is simply to seem like you're having your picture taken, which could be used for headshots or other resume pictures (although a more powerful camera would most likely be necessary). Another would be to show exactly the pose you want to capture, rather than make concessions for holding the camera or holding the camera less shakily.

This was my endeavor. It arose from my desire to take selfies of specific poses in the gym, and more still shots while doing something that makes it very difficult to hold a camera still (essentially, certain flexes). Unfortunately, this project as it was laid out is not currently possible. The Bluetooth technology for it exists, to a degree. Bluetooth technology is broken apart into about 25 different "profiles", each of which allows access for different things. The most commonly used profiles are GAVDP, AVRCP, A2DP, and a few others, but these are the ones commonly used and necessary for controlling the audio function of a device. Profiles for what I wanted to accomplish do exist, most notably the VDP (video distribution profile), which allows for sending a constant video stream from a source to a sink; and BIP (basic imaging profile), which allows for image push and pull, a couple automatic functions, and most importantly, remote camera. This was the profile I decided would be the most likely to complete the task I want. (wikipedia)

III. Methodology

So the bluetooth profile is there, but that's not all that's required. First, while the profile is there, the technology largely isn't. Bluetooth currently has a max throughput of about 80 kb/s. Image transfer speeds for a camera with maximum 2592 pixels x 1944 pixels and a max shutter rate of about 30 fps come out to about maximum 1.2 gbps. That's a no-op. And even if the speed were there - which actually may be possible in the not-too-far future, as there is work being done on a UWB (ultra wide band) protocol - the phone that I have access to (and most likely all phones on the market for the time being) has an OS that doesn't support either VDP or BIP. (sprint) Further, though I did get my phone and raspberry pi to connect via Bluetooth, I found that the profiles aren't already included on a Bluetooth device, they need to be written and implemented, and as far as I could find there are simply no templates on how to make a Bluetooth profile. So the Bluetooth aspect of this project fell apart.

Now, all this means is I had to tackle my project in a new way. I couldn't make it work the way I wanted, but I could still make it work. James Moore wrote an app for iOS that was able to interact with the pi camera and, luckily for me, someone wrote an android equivalent. (berrycam) From there it was a simple matter of getting the pi camera working with the app and I had a sort of makeshift version of my selfie pi. Before I stumbled across this, however, in my desperation to find a way to make Bluetooth work, I found many different cameras that seemed to accomplish what I wanted (but in the wrong way), particularly this Axon camera by Taser. (taser.com) But obviously a device wasn't going to help me, and the Bluetooth aspect of it is debatable at best - more likely, it uses wifi technology for its "streaming" to your phone. Unfortunately, the tech behind this was not available to me so I don't know how the underlying mechanism works but it's still a cool concept worth taking a look at.

Because the option of connection that is available to me (connecting to my phone via a network), I wanted something a little more transportable. Instead of Bluetooth, the app I found

(by Mike Redrobe) allows you to do image transfer via SSH which is significantly faster and more capable (unfortunately for the integrity of my original project). And yet it's still not very fast. But for the sake of transportability, I wanted something a little more unique than just having the two connect over a network and take pictures - so, I have the pi connect directly to a hotspot created by my phone. It's much more secure (not that security was a real issue in this case) than attaching to a public network and you can have a hotspot anywhere you have 4G; in fact, you may still be able to connect the pi to the camera without needing any connection to the internet, as long as the Hotspot can still be maintained. I tried to test this theory using Airplane Mode on my phone but, unfortunately, Airplane Mode disables network abilities including the mobile Hotspot. My instinct says that it should work, however, due to past experiences where I was connected to a network that failed to connect to the internet - however, this connection timed out without internet and was therefore short-lived. Even a short-lived connection would be useful, though - only a couple minutes are needed to take the picture. It is possible that the hotspot would be unable to be created without connection to 4G but this is becoming a more and more rare possibility, even deep in the wilderness. The objective is essentially attained: it is possible to carry a small device (not as small as intended, but it is after all a prototype) that can be used to take stationary, high quality selfies (and even with a 5 s delay timer).

Some small changes that might be made for a final quality product may actually be to incorporate Bluetooth in a different way. Using Bluetooth, it is very likely that it is possible to transfer an internet-login configuration file such that a device without any real sort of SSH and without a screen can access a specific internet source. This could be an app written for a phone that transfers the information used for the hotspot via Bluetooth, which can then be contained on a small camera with the clips and suction cups and whatnot which, while on, tries to connect to WiFi and, if the Hotspot is active, would automatically connect - thereby creating a

small version of the project that still accomplishes the objective (and even gets to use the Bluetooth aspect). I would test this myself if I had an app or enough app knowledge to write such an app, but I am confident this one would work - more so than trying to transfer the data itself via Bluetooth. From here, it was a simple matter of making the pi transportable. With everything being pretty small and contained within the case, all I really needed was a portable power source.

Various other issues I came across were mostly research related. There is very little information on profiles and even less on how to make one. Worse would be trying to make one work. The project uses the Pi camera and its library functions, but really nothing else. Photos aren't even stored on the Pi and therefore do not take up any memory (which is why the streaming is essentially possible). Saving a photo stores it in a specific folder on the phone which is SSH'd into the Pi.

IV. Alternative Uses

Although security is not an issue in this case necessarily, since the Pi is likely connected to a private hotspot network, it is possible to, say, have someone SSH into your Pi via the public network you're alternatively connected to. For this matter, it's a simple task to increase the security on the Pi itself - with an Uncomplicated Firewall (UFW), you can simply block SSH access to all ports you don't want your Pi listening in on. The app originally tries to access Port 22 but there are thousands of port options that the app can try accessing - 22 is the default SSH port, but intrusions are most commonly through other unmonitored ports. Thus why blocking port access could essentially solve the problem of security, if it were ever to be an issue. It's a simple matter of altering the SSH configuration file to change what port the Pi is listening on.

There are, of course, alternative uses for such a device. Axon is a perfect example, so police can record situations (it even has a 30 second buffer so they never miss a recording). Other military uses could include a back camera sending its feed into an HUD for special ops missions, which - though extremely slow in its current state - could be useful for watching one's own 6. This is not likely a necessary situation in current military training (two man teams are the typical minimum) but could be useful for one-man teams in the future, with a new training regimen. Of course, watching one's own back is useful, but with the current framerate it wouldn't cut a scenario like that and it could only be used with an HUD, something that shows the user what's going on behind him without having to check his phone - and would require special training to get used to. That said, if the tech were sped up enough, the camera itself could combine with human detection technology (or the motion detector could be used) in order to create a sort of autonomous back-watching system that might not even need the HUD.

An alternative use of the camera is a security cam. The Pi, when connected to the internet with port forwarding turned on, can be SSH'd into. As a security camera, you can start taking a constant stream of what's going on via the internet. Of course, it's not a particularly GOOD security camera since it wouldn't be constantly running, but it would be a convenient way to check the state of things at home through an internet connection. The project could obviously easily be modified to make it work more for a security camera, of course, but this would require a different app - or a different approach.

This actually relates to my original project concept which was just too broad of an undertaking. It's not that I thought it was too difficult but rather, too many concepts brought into one idea that are already so well-managed by smartphones. The concept I was originally going to pursue was a "smart house" AI, which would essentially use Cortana or Amazon Echo and an amalgamation of sensors to create a personal assistant throughout the house for minimal cost.

It could use the thermal/motion detector to track the rooms people are in (to save power in the house and for things like alerting the fire department when there's a conflagration, denoting where in the house a creature's thermal signature was last detected), detecting fires, telling the residents if there was rain; it could even be used to detect a baby's cry. For under a thousand dollars, you could turn your entire house into an automated butler, keeping track of appointments, playing music in the room you're in, listening to commands and essentially being a smartphone in house form (with more sensor options and therefore even more capability). This project idea arose from Vinclu's Gatebox hologram assistant, (cnet) announced earlier this year, combined with a desire to see it pan out using the video game *Halo*'s AI, Cortana (also used by Microsoft) as the hologram rather than the anime character. However, again, this was an amalgamation of small projects that ended up not panning out and were simultaneously too much and too basic an undertaking to go through with. But, were the smarthome idea to pan out, this project could still be incorporated.

Say you have a camera set up that is activated by a motion detector. Code in the Pi could take the picture and run a facial recognition algorithm on whoever entered the house. If it's a resident, it wouldn't do anything, but a non-resident and the Pi could send an alert to your phone via the internet, allowing you to take a picture of the entrant. If it's someone you recognize, no problem, but if it isn't then you could save the picture and have a dead-accurate description of the intruder (unless they're masked) - plus, masked or not, you could call the cops right then and alert them to an intrusion in your house. Of course, facial recognition code does not come so cheaply, but the entire concept of a smarthome was something I believe could be implemented easily and cheaply to any house within a short amount of time using one or multiple Pi's and (preferably) hologram technology.

V. Conclusion

While it is unfortunate I forewent the undertaking of the smarthome, and significantly more unfortunate that the Bluetooth aspect of my original project did not pan out, I'm very pleased I got my Pi to where it is. It works as a selfie cam and I did get Bluetooth to a point where my phone and Pi recognize each other, for which I am very proud. The project seems more simple now than it did when I first began the undertaking - especially, I think, because I had to make some concessions that ended up making it a lot easier. Still, I think the best part of this is that I learned a lot about the capabilities of Bluetooth and how it works. Despite it not working for my project in the way I wanted it to, Bluetooth is very cool technology that has been cleverly adapted for various goals, even though it was (likely) not intended for those goals in the first place - namely, the ability to take a picture via the Bluetooth audio control function. In the future, I think an adaptation of this project is certainly viable. For example, even without the necessary profiles for the project's original objective, it could be possible to emulate the app I used via Bluetooth rather than WiFi (although this will likely use lower speeds and I would only pursue it if the network access doesn't work without 4G, or until the UWB protocol is available), using file transfer profiles rather than BIP or VDP (which would take over some aspect of the phone directly instead of needing an app to facilitate the interaction). Of course, with technology growing as quickly as it does, even the original project may be viable in the not-too-distant future. Overall I think the project was a success in the face of adversity, especially when even completing it to the point I've achieved seemed bleak. It's unfortunate that the technology for what I wanted to do was unavailable and illogical to use in its current state, but again, I'm pleased that I was able to get the primary intended function to be operational. It's a little large for what I wanted and certainly doesn't clip onto a shirt (nor does it have a feasible way of sticking to a mirror or hooking onto another surface), but in this prototype

form, that is perfectly fine and I’m confident that with as simple as this project was in its implementation, compacting it into a small camera with Bluetooth (for the login information transfer) and WiFi (for the actual objective) and a clip/hook/suction cup (for mounting) and a battery (for transportability) would be a none-too-difficult task that would revolutionize gym selfie taking.

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