## TV Remote Begone Testing

Protocol Title: TV Remote Begone Testing

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1. **Abstract**

TV Remotes are not the most natural interface, and also come with a lot of problems. From an interface perspective, there are a wide variety of controls, especially on older remotes. Part of the appeal of streaming sticks is the simplification from 100+ buttons to sometimes less than 10 buttons to navigate and control the television. Additionally, controlling a TV traditionally has required a remote in your hand. If you have lost the remote (a common occurrence), or your hands are preoccupied or dirty, you cannot control your TV.

Gestures have had their time in the spotlight as an interface over the past 20 years. They have fallen out of favor, but mainly because of the domains where they were applied. If you have a complex interface, gestures are difficult to use because there are only so many natural gestures you can use - swiping left or right, rotating, sticking up fingers, etc. We don’t want to require users to learn a subset of sign language in order to send hundreds of commands.

TVs only have a limited number of commands to start with, as referenced above. Combined with voice search, a list of commands such as “up”, “down”, “left”, “right”, “volumeUp”, “volumeDown”, “volumeMute”, “power”, “fast forward”, and “play\pause” would capture nearly all of the functionality required for a streaming service. Hence, even limited gesture actions may be enough to effectively control a TV.

We have prototyped a gesture controlled TV using an Intel RealSense Depth Camera, a machine learning algorithm to classify gestures, and a Roku. Our aim is to see if users can comfortably interact with the TV, and if this is better than a remote-controlled TV.

1. **Study Aims**

We want to answer the question, could users see themselves using a gesture controlled TV instead of a remote-controlled TV? There are many different things that need to be assessed in order to answer this question.

1. Is our gesture classifier accurate? With a remote, users can control the TV exactly how they want. You press volume up, and the volume increases. Our gesture classifier needs to be the same. For example, we can’t have the volume up gesture sometimes be misinterpreted as changing the channel. This can be answered using quantitative data. Are gestures being misclassified? Are accidental movements being classified as gestures? Are some gestures not captured at all? How many of each. The higher these numbers are, the less users will enjoy using our TV.
2. Is our set of gestures intuitive? An intuitive set of gestures is important so that users will have an easier time learning the gestures. If users had to draw a hexagon in the air to increase the volume, that wouldn’t be very enjoyable.
3. Do users like it? We can design the perfect interface, but it doesn’t matter if users don’t like it.
4. **Study Design**

Each participant will control the TV, directed by a list of objectives. For example, one objective could be “play the second show from the bottom”, or “fast forward 30 minutes”. Each participant will be given the same list of objectives to complete, to ensure uniformity across trials. The objectives will be comprehensive enough to require as many of the gestures as possible to be used. Participants will not be given instructions on how far they should be from the camera, or other things like what lighting should be like. This is done to test the robustness of our gesture classifier.

We are going to collect both quantitative and qualitative data. For quantitative data, we are going to measure the accuracy of our gesture classifier. This will allow us to easily compare different iterations of our gesture classifier. For qualitative data, we are going to ask our participants questions about their experience, aimed at gauging their thoughts, and how we could improve the TV.

Our study population includes friends and family members, because we do not have enough time in this project to gather a diverse pool of participants.

[Sample size]

The outcome of this study is that we will be able to say if gesture controlled TVs could replace remote-controlled TVs. Should this be true, our interface could also be extended to things like doors, speakers, projectors, etc. If we cannot answer yes to that question, we hope to explain what needs to happen for gesture controlled TVs to become common- whether it is a better set of gestures, a better classification system, or better technology, etc.

1. **Study Procedures**

We will recruit whoever is nearby, and willing to participate. This will most likely be friends, and family members, because at the time of writing this we have about one week to recruit participants. There is no exclusion criteria.

Participants will be provided with information about the study, through this script:

*We wish to see how a gesture controlled TV compares to a remote-controlled TV. We’ve prototyped a gesture controlled TV, and want to see how well you interact with it. We are going to give you a list of gestures, and what they do. Your job is to work your way through a list of objectives.*

1. *Turn on the TV*
2. *Play the third show in the second row*
3. *Fast forward 15 minutes*
4. *Pause it*
5. *Go back to the start*
6. *Increase the volume by 10*
7. *Mute the volume*
8. *Quit playing the video, and power off the TV*

We are going to collect the following quantitative data for each trial:

* The number of missed gestures (TV did not register at all)
* The number of incorrectly identified gestures (TV registered, but the gesture was incorrect)
* The number of correctly identified gestures
* The total number of gestures
* On a scale of 1-5, how easy was the TV to use?

For qualitative data, we’ve created a [Google form](https://docs.google.com/forms/d/e/1FAIpQLSczwERLVdt1QfrU5clf-0U0I1REDws25PPIICDTNC5Sqx-lXA/viewform?usp=sharing) that asks the following questions:

* What do you like about the TV?
* How would you improve the TV?
* Are there any gestures you had difficulty with? If yes, why?

At the end of the study, we have a short thank you for the participants: *Thank you for helping us, we will incorporate your feedback in our next iteration.*

# **Analysis Plan**

From our quantitative data, we can collect four average variables across each participant:

* Average proportion of gestures missed
* Average proportion of gestures incorrectly identified
* Average proportion gestures correctly identified
* On average, how easy it was to use the TV (some number between 1-5)

We can take these four variables and compare different iterations of our TV. The goal is to minimize the proportion of gestures missed and the proportion of gestures incorrectly identified, and to maximize the proportion of gestures correctly identified and how easy it was to use the TV.

# **Pilot Study**

Run a Pilot study on your partner(s).

Did the study work? What did you have to change?