Netflix Control Method Using Smartwatches and Continuous Gesture Recognition

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***Abstract*—This work proposes and evaluates a method for interaction and control of Netflix using continuous recognition of gestures in smartwatches. This method allows the user to pause, resume, rewind, move forward, increase and decrease the volume of the Netflix player using gestures similar to traditional icons for these tasks. The recognition of gestures is done using the algorithm of continuous recognition of gestures, so it is possible to recognize a gesture before it is finalized, in this way, it is possible to perform the action quickly thus improving the feedback to the user. We have developed a prototype for smartwatches that communicates with a communication platform that receives the actions and is responsible for executing them on Netflix. When performing a gesture, the first step is to recognize it, in sequence, the gesture is sent to the interaction platform and, finally, the action related to the gesture is performed. We performed an experiment with users and a usability and experience test, the results show that the gestures proposed in the method are intuitive and that it has the potential to be used in a pleasant and satisfactory way by the users.**

***Index Terms*—smartwatch, player, controller, Netflix, gesture recognition, continuos gesture recognition.**

I. Introduction

Smartwatch is a small computer in the shape of a clock, this way it is a smart wearable device. By being coupled to the user's body, it can make people's daily lives easier [5, 6]. Because they are small devices, interaction with them is a challenge, but there are several searches for interaction with these devices being developed. One of the lines of research is to use the smartwatch as a remote control [1, 6, 9].

Streaming services have existed for some years, however, in recent years they have gained more space and are present in the lives of several people and in different devices [4]. The four largest on-demand adaptive streaming services, i.e., Netflix, Youtube, Amazon Video, and Hulu contribute with 55% of the Internet traffic [2].

Netflix is a subscription service that provides movies and series via streaming and is present in several countries with millions of users worldwide [8, 10].

Due to the popularity of Netflix and the increasing use of smartwatches, this work proposes the development of a method that allows controlling the Netflix player using smartwatches. To this end, it will be necessary: to recognize gestures, to relate each gesture to an action in Netflix intuitively, and to send the action and to execute it in Netflix.

In this article, we present the results of the research to interact with the player of Netflix using smartwatches and continuous recognition of gestures.

The next sections present contents that are relevant to the understanding of the results obtained. The next section discusses the related works. In sequence, it will be addressed the communication platform, soon after, the prototype for smartwatch, then the study with users along with the results, and finally the final considerations.

II. Related Work

The work developed by Zhu et al. [12] presents a deep neural network based on bidirectional Long Short-Term Memory (LSTM) that can recognize the gestures movements of the user's wrist and fingers. The results show that the system has the potential to use smartwatch as a remote control.

Gkournelos et al. [1] developed a method that allows controlling robots using smartwatch as a control mechanism.

In Luna et al. [5], it was developed a method to control Smart TVs using gestures made by the pulse of a person using smartwatch.

Speier et al. [9] developed a prototype to control a music player using a wristband attached to the user's wrist and the results of this work show that users prefer gestures that slide to touch gestures.

With the focus on device development, the work proposed by Volkinburg and Washington [11] developed a wearable controller based on gesture recognition.

Using continuous gesture recognition, Nascimento et al. [7] proposed a method of text entry based on gestures in smartwatches. The results of this work show that users have adapted well to the method and that the algorithm of continuous gesture recognition is efficient in smartwatches.

In our previous work we present a method that allows to control platform games using smartwatch and continuous recognition of gestures [6].

As can be seen in this section, researches are conducted to develop new methods of interaction with smartwatches, as well as research with continuous recognition of gestures and research using new methods of interaction with video players. However, none of these studies addressed the use of

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continuous gesture recognition in smartwatches as a mechanism for interacting with the Netflix player. Therefore, this work is based on the method presented in [6] to develop a communication platform to control Netflix using smartwatch as a control mechanism.

III. Communication Platform

Several devices can run Netflix, such as the PC, Smartphones, Smart TVs, among others. In this work Netflix was run on a PC with Intel Core i7-5500U 2.40GHz, 8GB of RAM and NVIDIA GeForce 830M video card.

We developed a communication platform that is responsible for receiving the gestures performed in the prototype and performing their respective actions on Netflix. Communication between the prototype and the communication platform is performed using a wireless local area network (WLAN). To perform Netflix actions, we have developed a service that simulates the actions of pressing and releasing keyboard keys. Fig. 1, illustrates the communication process between the prototype and the communication platform.

Fig. 1. Communication model using a WLAN between the smartwatch prototype and the communication platform.

In this way, when performing a gesture in the prototype, it is send to the communication platform that is responsible for simulating the pressing of a key to perform the action that the gesture represents.

IV. Prototype for Smartwatch

A. Continuous Gesture Recognition

We used the algorithm of continuous gesture recognition proposed by Kristensson and Denby [3]. This algorithm is able to predict partial gestures, i.e., a gesture can be recognized before it is finalized, in this way, it is possible to perform the action quickly, thus improving system feedback.

For this, it uses a technique that considers a gesture as a model and divides it into segments. Thus, each gesture is a model that has a set of segments describing increasingly, the partial excerpts of the model [3]. Fig. 2, illustrates this technique.

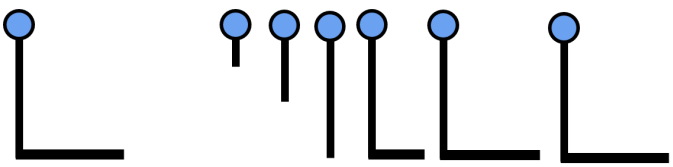

Fig. 2. Full model to the left and segments of the gesture to the right. Adapted from [3].

A model can be considered to be a vector of ordered points in relation to time, that is, a vector of ordered points relative to the way the movement is to be produced, a gesture is segmented in several parts and in increasing movements. A model represented by w is a pair (l, S), where l is the model description and S is a set of segments that describes the complete model. The Equation 1, describes a complete model ordered in relation to time T [3].

$$S = [s_1, s_2, ..., s_n]^T \tag{1}$$

B. Prototype Developed

We developed a prototype that allows the user to interact with the Netflix player using smartwatch. Using this prototype, the user can pause, resume, rewind, move forward, increase and decrease the volume of the Netflix player using gestures similar to traditional icons for these tasks. In the prototype, each gesture represents an action to be performed on the Netflix player. Fig. 3 shows the gestures and their respective actions in Netflix.

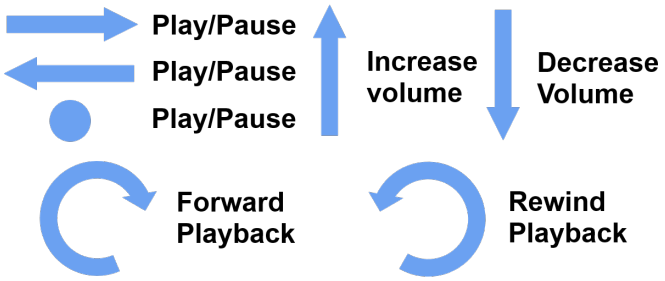

Fig. 3. Set of gestures and their respective actions in the Netflix player.

Since gesture recognition is continuous, it is not necessary for the user to finalize the gesture so that it is recognized. In this way, the prototypes were designed to send the action to Netflix when the player performs of at least 2 cm and with the minimum recognition accuracy of 70%.

The linear gestures of the set were generated from the reduced equation of the line, represented in the equation below. Where x and y are the points belonging to the straight line and c the linear coefficient.

$$y = mx + c \tag{2}$$

The gestures that contain curves were generated by the reduced equation of the circumference, represented in the equation below:

$$x^2 + y^2 = r^2 \tag{3}$$

In Equation 3, x and y represent the points belonging to the circumference and r represents the radius.

The prototype was developed for the Android Wear system. Fig. 4 presents the prototype interface running on the *Motorola Moto 360* smartwatch.

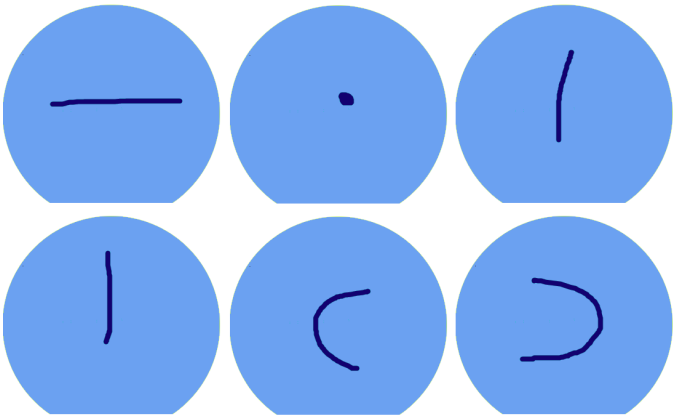

Fig. 4. Prototype interface on *Motorola Moto 360* executing the actions: pause, play, increase volume, decrease volume, forward playback and rewind playback.

V. User Study

The experiment was conducted with 10 participants aged 21 to 39 years with the average of 28 years. Of these, one is a undergraduate student and nine postgraduate students, of whom two are also teachers. All participants are from the computing area. Three participants had their own smartwatches.

Regarding the experience with smartwatches, 1 of the participants stated to be very experienced, 1 said to be experienced, 2 said to have regular experience, 5 stated to have little experience and 1 stated that they have no experience.

During the experiment, 1 participant used the smartwatch in his right wrist, perfoming the gestures using his left hand, even though being righ-handed; and the other participants used the smartwatches in their left wrists.

In order to validate the developed method, the prototype was installed in the *Motorola Moto 360* smartwatch.

Before starting the experiment, the prototype and its functionalities were exposed to the experiment participants. The set of gestures available for use that are shown in Fig. 3 was exposed to the participants and they were able to observe them throughout the experiment. For the experiment, the prototype shown in Fig. 4 was used.

A. Usability and Experience Test

In order to evaluate the usability and experience of the developed method, a questionnaire was applied to the participants of the experiment who answered usability and experience related statements to verify the efficiency and effectiveness of the proposed method. The questions were answered by the participants using the Likert scale. The affirmations applied to the participants were:

1) The gestures proposed for using the method are intuitive.
2) It is easy to use the method, i.e., it was easy to control Netflix using the prototype in the first few minutes.
3) The actions performed on the prototype are sent correctly to Netflix.
4) The actions performed on the prototype are performed quickly and satisfactorily on Netflix.
5) It is nice to control Netflix using the proposed method.
6) I would use this prototype to control Netflix in my everyday life.

Section VI will discuss the results of the experiment as well as the usability and experience test.

VI. Results and Discussion

The prototype was used to perform a study with users, for which a usability and experience test was performed aiming to validate the developed method, as well as the prototype and the communication platform. Fig. 5 shows the responses of the experiment participants to the usability and experience test statements.

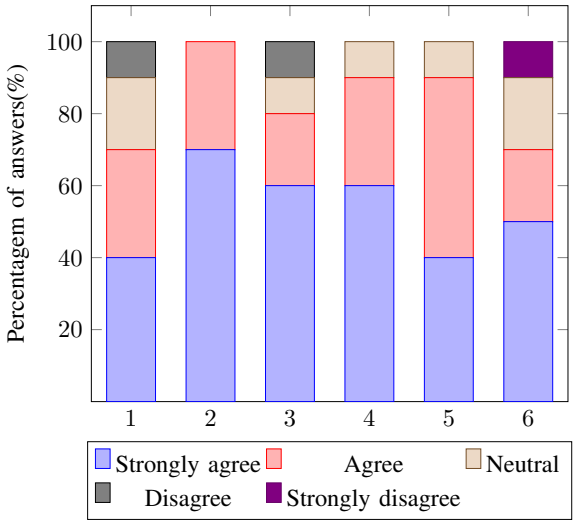

Fig. 5. Experiment participants' responses to the questionnaire applied to experience and usability.

It is observed in item 1 of Fig. 5 that most users stated that the gestures proposed in the method are intuitive because 40% of users said they fully agree and 30% said they agree, totaling 70%. Only 20% claimed to be neutral and 10% disagreed.

The participants' answers to item 2, show that it is easy to use the method to control Netflix, because all the participants said to agree or to agree totally.

The responses to item 3 regarding the correct submission of the shares to Netflix show that for 80% of the participants the actions were sent correctly, because, they affirmed to agree or to agree totally.

Regarding the response time for performing the actions in Netflix, our tests show that the time for executing an action on Netflix after the execution of the gesture was less than 70ms. Considering item 4 of Fig. 5, it is observed that 90% of the participants stated that they agree or fully agree that the actions taken in the prototype are sent quickly and satisfactorily in Netflix.

Considering if it is nice to use the method, 90% of participants also stated that it is nice to control Netflix using the proposed method, as can be seen in item 5 of Fig. 5.

As observed in item 6, which refers to the use of the method in the daily routine, 70% of the participants stated that they

agreed or totally agreed that they would use the method in their daily lives, 20% stated that they were neutral and 10% stated that they would not use in everyday life.

The participants of the experiment had the opportunity to make open comments about the proposed method, being able to make critics, give suggestions and suggest improvements. Some participants suggested changing the functions of the gestures straight to the right and straight to the left to advance and rewind the video respectively. Other participants suggested using circumferences to increase and decrease volume.

It can be observed according to the response of the participants that the developed method has the potential to be used in the daily life of the people, the proposed gestures are intuitive, but a new experiment can be done with different gestures. It is also observed that the response time is satisfactory and that the prototype has the potential to be pleasant when using it.

VII. Final Considerations

This work proposes the development of a method to control Netflix using continuous recognition of gestures in smartwatches. For this, we created a prototype for smartwatches and a communication platform that is responsible for receiving the gestures realized in the prototype and executing their respective actions in the player of Netflix.

In this way, to execute an action, the user uses one of the gestures exposed in Fig. 3 on the smartwatch, after this, the gesture is recognized, in sequence, sent to the communication platform and related to an action, and by end, the action is sent and executed on Netflix.

By using the algorithm of continuous gesture recognition, the user does not have to finalize the gesture so that it is recognized, in this way, the action is executed faster in Netflix.

The results of the usability and experience test show that the method developed has the potential to be used in the everyday of users and also has the potential to please them, besides allowing the control of Netflix using smartwatches with continuous recognition of gestures in an efficient and effective way. Thus, it is expected that the method can be used by Netflix users.

The next step of this research will be to add new control gestures to the method and consequently carry out a new study with users to define which gestures are most recommended to perform a certain action. Later the method developed will be tested in other players such as YouTube and Google Movies, as well as music players like Spotify and Youtube Music, for instance.

Acknowledgments

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