Relatório de atividades realizadas em viagem realizada a Universidade Federal de Santa Maria

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1- Resultados Obtidos

Atividades em conjunto com docentes e discentes da UFSM sendo que, um deles, resultou em artigo aceito em evento nacional.

2-Atividades desenvolvidas nas missões

Primeira Semana

- Me apresentei no dia 17 de julho junto ao Professor Pozzer
- Participação de Prévia de Proposta de Dissertação de Mestrado
- Estruturação de artigo a ser escrito na segunda semana
- Adequação do ambiente de trabalho junto ao aluno de graduação (Guilherme Gonçalves Schardong)

Segunda Semana

- Revisão de literatura sobre Reconhecimento de Movimentos tendo como base de estudos a Visão Computacional – Trabalhos que envolvem reconstrução 3D.
- Presença na Defesa da dissertação de mestrado do aluno Fernando Bevilacqua

Terceira Semana

- Revisão de literatura sobre Reconhecimento de Movimentos tendo como base de estudos a Visão Computacional – Trabalhos que envolvem tracking.

Quarta Semana

- Acompanhamento da implementação do Filtro de Gauss e Filtro Sharpness com Bruno Rezende Laranjeira, aluno de graduação da UFSM.
- Atividades de programação

3-Demais atividades resultantes do financiamento

- Discussões com os professores da UFSM sobre o andamento dos trabalhos relacionados a pesquisa de tese de doutorado e futuras colaborações entre o aluno e os professores. As discussões foram realizadas com os professores Marcos D'Ornellas e César Pozzer.

4-Resultados concretos em termos de publicações

- **O artigo escrito no período da missão foi aceito no VIII Simpósio Brasileiro de Jogos e Entretenimento Digital (SBGAMES 2009) que ocorrerá entre os dias 8 e 10 de outubro de 2009 no Campus da PUC-Rio, no Rio de Janeiro**.
- As discussões com os professores bem como as atividades realizadas no período destinado a missão colaboraram para o aluno de doutorado da UFF, André Luiz Brandão, para que seja realizado um trabalho bastante enriquecedor, não só ao aluno como para ambas as instituições, já que envolve linhas de pesquisa que convergem e, o primeiro resultado parcial foi satisfatório, tendo em vista o período de quatro semanas para o desenvolvimento das atividades realizadas.
- Pretende-se dar continuidade as atividades com colaboração em conjunto, tanto em pesquisas referentes ao trabalho de tese como para colaboração de ambas as universidades envolvidas nas quais podem estar presentes, tanto alunos de graduação como mestrado e doutorado.

Em anexo, o texto aceito no SBGAMES 2009.

Stimulating imitation of children with Down syndrome using a game approach

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Abstract

The usage of computer games by people with special needs sometimes can be difficult because some of them are not used to interact with a keyboard, mouse or gamepads. Some computer games even offer different paradigms of interaction but are no specifically designed to help people with special needs. We are currently facing the problem of developing a game to help Down syndrome children to interact with computers by the means of imitation. Our work presents the first step to provide an interaction framework to automatically recognize broad movements using computer vision concepts for movement recognition.

Keywords: movement recognition, people with special needs, Down syndrome, children

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1. Introduction

Recent works in Computer Science are showing that people with cognitive impairment have been using more computer applications in the last years [Feng et al, 2008]. Some of these studies pay a special attention to people that have special needs such as autism [Veeraraghavan And Srinivasan, 2007] and Down syndrome [Feng et al, 2008; Marti, 2009]. However, even presenting promising results based on experiences with people with Down syndrome, the authors did not find any game that was developed specifically for this kind of user.

Some studies presents results that demonstrates that people with a special kind of cognitive impairment, in our case, Down syndrome, can use mouse with difficulties but is very hard to other forms of interaction, like keyboard and gamepads [Feng et al, 2008]. Down syndrome affects an individual's overall development, including areas such as cognition, sensory perception and processing, gross and fine motor skills, and also short term memory [Abbeduto, 2001; Kumin, 2003].

At the same time, speech therapists have been trying to stimulate users with impairments by observing their interaction with games. However, these games are not developed for people with such impairments. Specifically, we have not found any game developed for children between 3 to 5 years old with Down syndrome. We designed the JECRIPE game to fit this niche, and in this paper we describe some challenges that need to be tackled.

Our proposal is to offer a different paradigm of interaction between users and games that applies movement recognition based on Computer Vision techniques. The goal of this work is to develop algorithms to extract characteristics from frames of video in real-time with the use of Graphics Processing Unit (GPU's).

This paper is organized in three more sections. In section 2, we describe some related works about interaction of Down syndrome children and movement recognition. Section 3 presents some movement recognition concepts and some highlights of our game. Finally, in section 4 we expose some concluding remarks and future work.

2. Related Work

We decided to divide this section in two parts: in this first we compare our work with some research on the interaction of children with Down syndrome and computer games; the second part will present some related work on movement recognition based on computer vision algorithms.

2.1. Users with Down syndrome

There are some works with users with impairment; some of them are about autism [Marti, 2009] and others in our context: Down syndrome. We highlight two of those works: Computer Usage by Young Individuals with Down syndrome [Feng et al, 2008] and Creative Interactive Play for Disabled Children [Marti, 2009].

The first work [Feng et al, 2008] presents experiences with people between 4 and 21 years old with Down syndrome. It was made a survey asking how people with Down syndrome make use of computers. In specific questions about input device, the most cited were keyboard (85.6%) and mouse (93.2%). Other input devices cited were: touch screen (12.3%), joystick (7.5%), touchpad (5.5%), trackball (4.9%), speech recognition (3.4%), stylus (2.3%) and keyguard (0.4%). One of the conclusions of the work was people with Down syndrome have much difficult to use mouse and specially keyboard because they have fingers shorter than usual.

Other work [Marti, 2009] exposes different manners of interaction of handicapped children with computers. One kind of interaction mentioned was a remote controlled robot used by a seven year old boy with autism. Other robots were used in experiences, some of them, social robots. The objective of the work [Marti, 2009] was to collect and discuss research from robotics to interactive environments and tangible media promoting play for physically, visually and hearing for different handicapped children.

Those works showed important concepts and results for our work, but is difficult to find a great number of papers that use experience with handicapped children, especially with Down syndrome children, interacting with computers [Feng et al, 2008]. Based on results of [Feng et al, 2008] it's perceptible that is necessary to make different manners of interaction. Our objective is not the same as [Marti, 2009] because we want to take care of only children with Down syndrome at this moment. In the next section we describe how the movement recognition will work in our search.

2.2. Movement Recognition

Several types of motion capture systems are presented in the literature and some of them were instrument of interest in our work. The types of motion capture that we were interested are: Marker-based motion-capture, Color markers and Bare-hand tracking.

Marker-based motion-capture: these systems require obtrusive retro-reflective markers and many camera setups [Park, and Yoon, 2006]. Our pretension is to make use of one single camera to make less expensive for users, so we discarded this option.

Color markers: the usage of color markers are used in [Wang and Popović, 2009] and presented good results. The work introduced a special glove design consisted in large color patches accounts for camera limitations to identify the movements. Our approach has no intended to make use of gloves because our proposition is to identify movements of the body, not only color marked regions.

Bare-hand tracking: edge detection and silhouettes are the most common features used to identify the pose of the hand [Wang and Popović, 2009]. Our approach is intended to make use of this type of motion capture technique but we are going to make use of skeletonization applied in skin segmentation. The work [Stenger et al, 2006] shows a Model-based hand tracking using a hierarchical Bayesian filter. It presents a set of contributions in this type of tracking like: a hierarchical filtering algorithm, which combines robust detection with temporal filtering and the formulation of likelihood function that fuses shape and color information, significantly improving the robustness of the tracker.

However the work [Stenger et al, 2006] exposes a good model, it is restricted only for hand movements. Our objective is to identify not only hand movement but either other parts of the body like head and neck. That's why were are going to use a skin segmentation technique and it is in development to present results in real-time, implemented in GPU, making use of a filter and thinning to handle body movements.

The next section presents our JECRIPE game which has the pretension to stimulate children with trisomy 21.

3. The JECRIPE game

Our game, named JECRIPE, is an approach to stimulate children with Down syndrome and in pre-scholar age. Studies have demonstrated that a few areas of cognition need to be stimulated to help the development of the kind of children that our game targets [Brandao, 2006]: **Imitation**, Perception, Fine Motricity and Visio-Motor Integration, Comprehension and Expressive Language. The JECRIPE game is currently in development and this work highlights the challenges in the development of the Imitation task of it.

Imitation has a fundamental relation with language acquisition [Schopler Et Al, 1990]. Learning words is part of the language acquisition and imitation helps in this process. Motor imitation must be learned before the language stimulation [Brandao, 2006]. Imitation also plays an important role in socialization, because through it a child learns how to behave, cooperate and respond [Brandao, 2006]. However, it is important to observe that the imitation capacity of children with Down syndrome is significantly lower than those without it [Guerrero López, 1997].

Figure 1: Illustration of an open arms movement.

Children with trisomy 21 (Down syndrome – DS) have the tendency to favor the use of gestural communication instead of spoken language, also avoiding combining vocalizations with hand drawings [Smith, 1987]. Another work [Tristão, and Feitosa, 1998], exposes the effectiveness of imitation on the verbal behavior of children with impairments, concluding that imitation plays an important role in language acquisition.

In view of the results of the mentioned works, the imitation will be addressed in JECRIPE game through the display of choreographed movements with music of public domain. In the Brazilian culture, there are some songs with choreography that exercises some movements. These movements include pointing parts of the body (hands, fingers, eyes, nose, mouth, ears, arms, hair), open the arms, and shake the body following the music's rhythm. Figure 1 and 2 illustrate some of these movements.

Figure 2: Illustration of a pointing movement.

In the game, this choreography is performed by a character with DS resemblance (Figure 3). The choice of using DS features in a character is justified because it facilitates the empathy between the user and the game character. There are no known games that use a DS character to date.

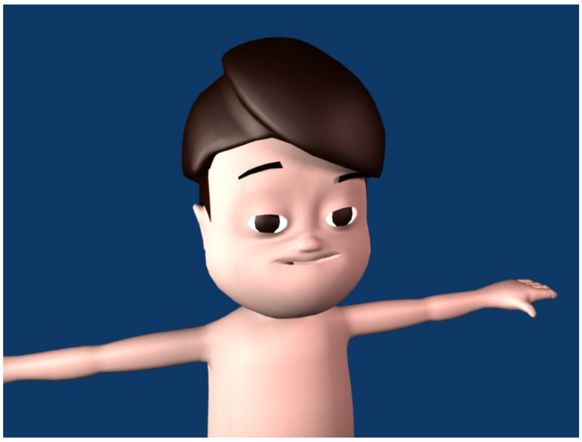

Figure 3: Character with Down syndrome characteristics.

JECRIPE players have to mimic the character, which is modeled in 3D and automatically choreographs the songs. The movement recognition module of the game is responsible to recognize if the movements are correct or not. Some of the choreographies are illustrated in Figures 4 and 5.

4. Expected Results

In this paper, we exposed some concepts of a game to stimulate children with DS. Our next steps are to conclude the development of the JECRIPE game, specially the movement recognition module mentioned in this text. Our goal is to offer an easy interaction for users with impairment, by recognizing broad gestures in front of a single camera. This kind of interaction may facilitate the interaction of this kind of user in comparison to a keyboard, mouse or gamepad.

Figure 4: Open arms movement by the character

We are implementing the necessary Computer Vision algorithms for movement recognition in CUDA [ref]. We plan to adapt or extend the model-based hand tracking using a hierarchical bayesian filter presented in [Stenger et al, 2006] for our needs. This extension is targeted to recognize broad body movements, instead of hand tracking only.

Finally, we expect to make experiments with children with Down syndrome in pre-school age (3 to 5 years old) to assure that this interaction paradigm is interesting for this kind of user. We believe that our work promises contributions to the Human-Computer Interaction and Computer Vision areas, at the same time helping people with special needs by the use of computer games.

Figure 5: Pointing movement by the character

References

ABBEDUTO, L., PAVETTO, M., KESIN, E., WEISSMAN, M., KARADOTTIR, S.,O'BRIEN, A. & CAWTHON, S., 2001, "THE LINGUISTIC AND COGNITIVE PROFILE OF DOWN SYNDROME: EVIDENCE FROM A COMPARISON WITH FRAGILE X SYNDROME". DOWN SYNDROME RESEARCH AND PRACTICE,7, 9-15.

BRANDAO, S. R. S., 2006. DESEMPENHO NA LINGUAGEM RECEPTIVA E EXPRESSIVA DE CRIANÇAS COM SÍNDROME DE DOWN. MÁSTER DISSERTATION, FEDERAL UNIVERSITY OF SANTA MARIA.

FENG, J. AND LAZAR, J. AND KUMIN, L. AND OZOK, A., 2008, "COMPUTER USAGE BY YOUNG INDIVIDUALS WITH DOWN SYNDROME: AN EXPLORATORY STUDY" ASSETS '08: PROCEEDINGS OF THE 10TH INTERNATIONAL ACM SIGACCESS CONFERENCE ON COMPUTERS AND ACCESSIBILITY PAGES 35-42 HALIFAX, NOVA SCOTIA, CANADA, ACM.

GUERRERO LÓPEZ, J. F. NUEVAS, 1997 PERSPECTIVES EN LA EDUCACIÓN E INTEGRACIÓN DE LOS NIÑOS CON SÍNDROME DE DOWN. PAIDÓS, BARCELONA.

KUMIN, L., 2003, "EARLY COMUNICATION SKILLS IN CHILDREN WITH DOWN SYNDROME: A GUIDE FOR PARENTS AND PROFESSIONALS". BETHESDA, MD: WOODBINE HOUSE.

MARTI, P. AND POLLINI, A. AND RULLO, A. AND GIUSTI, L. AND GRONVALL, E., 2009, "CREATIVE INTERACTIVE PLAY FOR DISABLED CHILDREN" IDC '09: PROCEEDINGS OF THE 8TH INTERNATIONAL CONFERENCE ON INTERACTION DESIGN AND CHILDREN PAGES 313-316 ACM, NEW YORK, NY.

PARK, J., AND YOON, Y. 2006. LED-GLOVE BASED INTERACTIONS IN MULTI-MODAL DISPLAYS FOR TELECONFERENCING. IN INTERNATIONAL CONFERENCE ON ARTIFICIAL REALITY AND TELEXISTENCE–WORKSHOPS (ICAT), 395–399.

SCHOPLER, E.; REICHLER, R.J.; BASHFORD, A.; LANCING, M.D.; MARCUS, L.M., 1990, PSYCHOEDUCATIONAL PROFILE REVISED (PEP-R). TEXAS: PRO-ED.

SMITH, L., 1987, THE STRUCTURE OF DIALOGUE IN EARLY LANGUAGE DEVELOPMENT: LONGITUDINAL CASE STUDIES OF DOWN SYNDROME AND NONRETARDED TODDLERS. IN: RAUTH, H. & H.C. STEINHAUSEN H.C. (ORGS), PSYCHOLOGY AND EARLY DEVELOPMENT, 201-213, NORTH HOLLAND: ELSEVIER,.

STENGER, B., THAYANANTHAN, A., TORR, P., AND CIPOLLA, R. 2006. MODEL-BASED HAND TRACKING USING A HIERARCHICAL BAYESIAN FILTER. IEEE TRANSACTIONS PATTERN ANALYSIS AND MACHINE INTELLIGENCE 28, 9, 1372–1384.

TRISTÃO, R. M.; FEITOSA, M.A., 1998, LINGUAGEM NA SÍNDROME DE DOWN. PSICOLOGIA: TEORIA E PESQUISA, 14 (2)127-137.

VEERARAGHAVAN, S. AND SRINIVASAN, K., 2007, "EXPLORATION OF AUTISM USING EXPERT SYSTEMS" INFORMATION TECHNOLOGY. ITNG '07. FOURTH INTERNATIONAL CONFERENCE ON 2-4 APRIL 2007 PAGE(S):261 - 264.

WANG, R. Y. AND POPOVIĆ, J. 2009 REAL-TIME HAND-TRACKING WITH A COLOR GLOVE ACM TRANSACTIONS ON GRAPHICS 28(3).