Obtaining Four Main Animation Cycles Using an Extremely Limited Set of Poses

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Abstract

We demonstrate that all walking, running, tired and sleeping animations can be obtained using only 12 key poses that can be organized as cyclic group in modulo 12 as shown in Figures 1 and 5. This significant reduction in key poses came from using some poses in both running and walking (See poses 3 and 9 in Figure 1) and using cartoon methods to indicate motion such as motion curves, words and droplets. This approach is useful to create continuous motion in games using limited number of animation poses. In fact, we used these animation modules in two fitness games that are used to collect motion data.

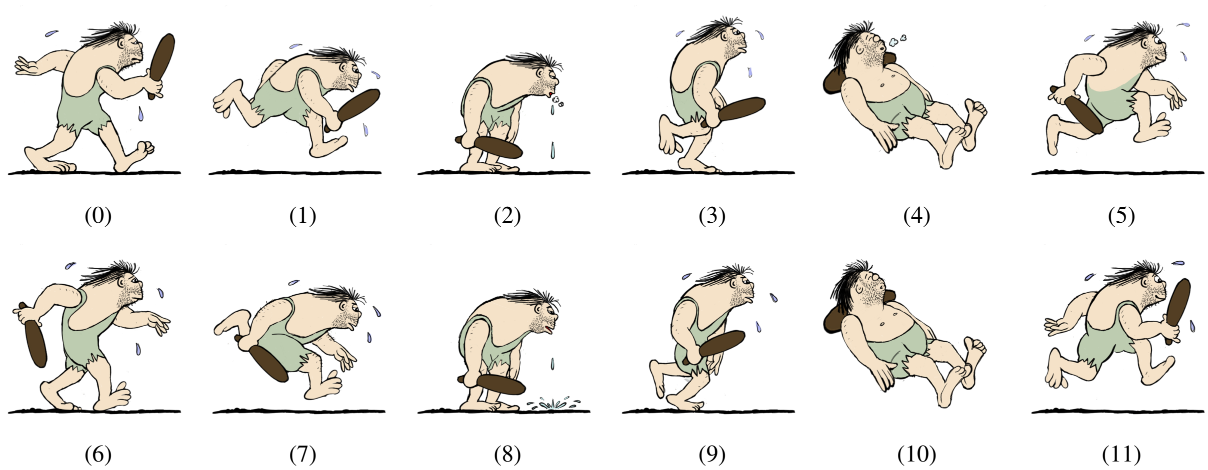

Figure 1: *The numbering scheme to create animation of walk, run, sleep and tired. We treat each pose of all cyclic animations as elements of a group* $G = (Z/12Z, +)$*, i.e. the integers mod* 12 *under addition. Each animation cycle is given as a coset of subgroup of G. Walk cycle is the subgroup* $(0,3,6,9)$*; Run cycle is* $(1,3,5,7,9,11)$*, which is a coset of subgroup* $(0,2,4,6,8,10)$*; tired cycle is* $(2,8)$*, which is a coset of the subgroup* $(0,6)$*; and sleep cycle is* $(4,10)$*, which is another coset of subgroup* $(0,6)$*. Since they are represented by cosets, these animation cycles can easily obtained by module 12 addition operations. For instance, walk cycle is closed under* $+3$*, run cycle is closed under* $+2$*. In this way, we can obtain four animation cycles using an extremely limited set of poses.*

1 Introduction

In this short paper, we present an approach to represent all four important animation cycles with 12 key poses. Our approach, that is based on group theory, allows to create four types of animations from these 12 poses, just by choosing a single number smaller than 12 and a modulo 12 addition operation. For instance, run cycle can be described using a starting point such as 3 and an addition with 2. We can then obtain all elements as the following cycle as $3, 3+2=5, 5+2=7, 7+2=9, 9+2=11, 11+2=1$. As it can be seen in this example, since these animations are cycles, the first number does not have to be smallest number in the subgroup. This also demonstrates specialty of 12 as a composite number that turns out to be very useful in applications involving time.

(0) (3) (6) (9)

Figure 2: *Cowgirl walk cycle:* $(0,3,6,9)$.

(1) (5) (7) (11)

Figure 3: 4 *poses from Cowgirl run cycle:* $(1,3,5,7,9,11)$. *Note that the recoil poses* 3 *and* 9 *are also used in walk cycle, therefore, they are not included in this sequence of poses.*

2 Motivation

With the widespread use of smartphones, many health and fitness apps have been developed to motivate people to be more physically active. Most of these applications promote competition among users to reach universal goals. In order to make competitions more appealing to the users, it is important to provide "limited" animations [7, 9] that can provide a visual representation of the competition through animated avatars. Since phones usually have limited amount of memory and computational power, it is also crucial to reduce memory and computational requirements to improve performance without sacrificing from visual and aesthetic quality.

Animation is an art form that provides expressive motion [7, 2]. To obtain successful animation, it is important to apply animation principles such as staging, curves, overlapping action, anticipation and follow through [8, 6]. Even in the limited animations, we cannot sacrifice these principles. Therefore, solutions must include animation principles even when we significantly reduce the number of frames for limited animation. Therefore, there is a need for the development of methods to reduce representation of essential animations as cycles without sacrificing animation principles. In this paper, we present an approach for reducing four main animation cycles without sacrificing animation principles [8, 6]. Our approach is successfully used in two earlier smartphone physical activity apps, *Walk'N Play* and *Move'N Play* [3, 5], that promote comparison

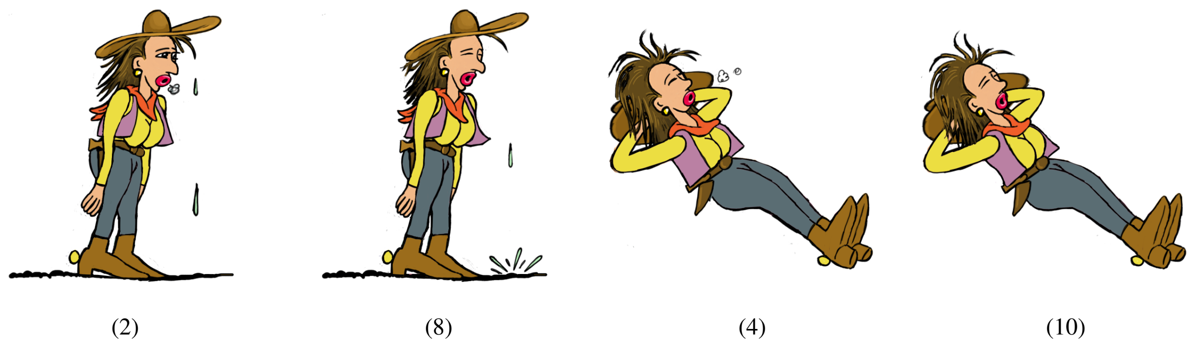

Figure 4: *Cowgirl tired (2,8) and sleep (4,10) cycles.*

and competition through animations. The current version of this physical activity app is available under the name of *IBurnCalorie* in Apple Itune AppStore [4].

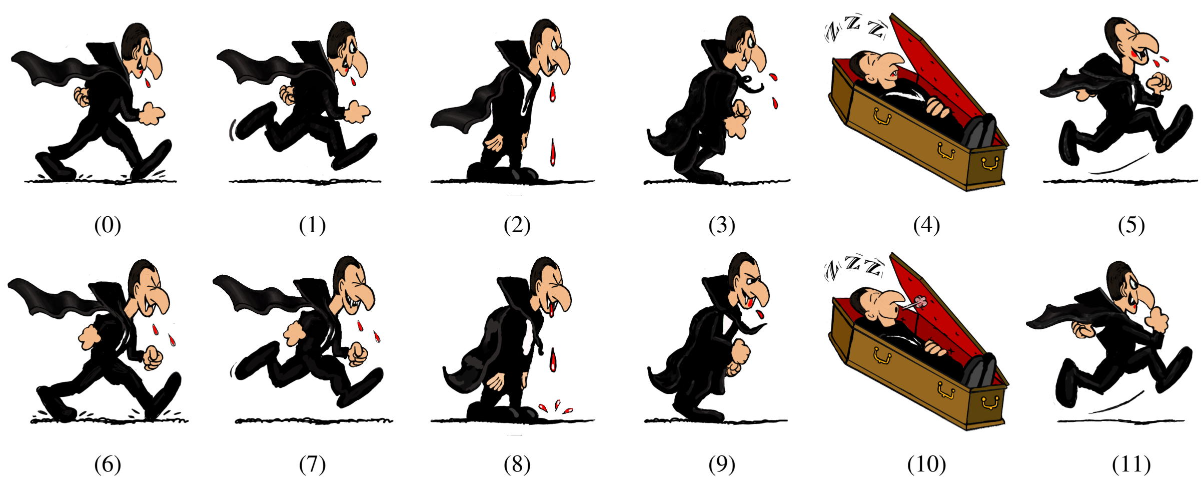

Figure 5: *We have included Dracula to provide an interesting competitor. An additional visual advantage is that Dracula sleeps inside a coffin.*

3 Contributions

From animation standpoint, the most significant contribution was to demonstrate that all walking, running, tired and sleeping animations can be obtained using only 12 key poses that can be organized as cyclic group in modulo 12 as shown in Figure 1. This significant reduction in key poses came from using some poses in both running and walking (See poses 3 and 9 in Figure 1) and using cartoon methods to indicate motion such as motion curves, words and droplets. Another important contribution is that we normally expect at least three poses to obtain a cyclic animation [1, 2]. We demonstrated that it is possible to obtain a seamless animation only with two images by adding elements that provide directions such as droplets (See Figure 4). These 12 poses can be good way to teach both animation and group theory in an integrated manner. Students can replace their own poses to obtain their version of the visual clock shown in Figure 6.

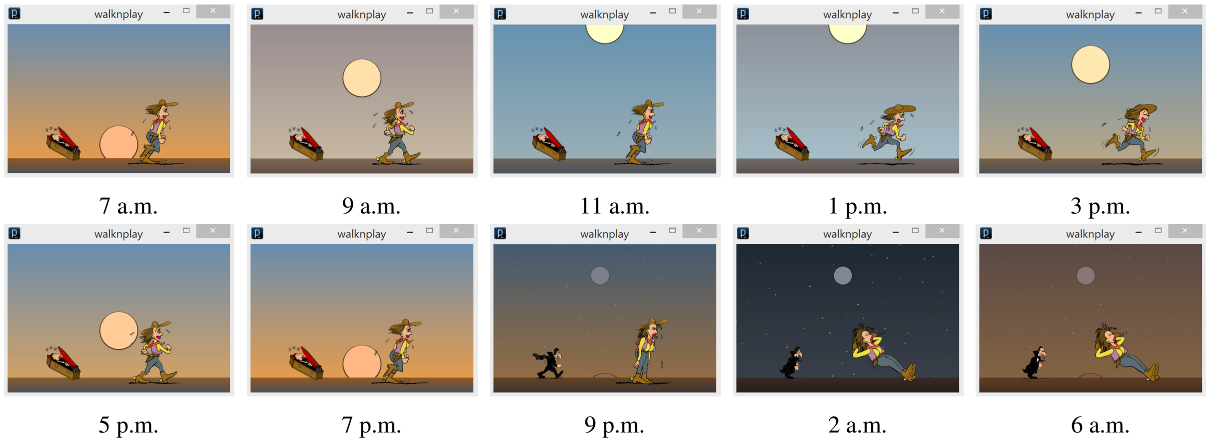

Figure 6: *We have also developed a clock program to test the quality of the poses. These are frames from our program that uses these 12 poses to create a visual clock. Sun and moon positions & colors and sky colors are automatically created based on clock cycle. Program is available upon request.*

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