

# From A-Pose to AR-Pose: Animating Characters in Mobile AR

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**Figure 1:** With AR-Pose a smartphone functions as a 3D cursor (yellow sphere) that selects and manipulates IK handles (blue spheres) for articulating the underlying rig of a humanoid character. Through a control panel placed in the workplace, a user can then define and save a sequence of poses to latter reproduce them as an animation.

## ABSTRACT

We present AR-Pose, a mobile AR app to generate keyframe-based animations of rigged humanoid characters. The smartphone’s positional and rotational degrees of freedom are used for two purposes: (i) as a 3D cursor to interact with inverse kinematic (IK) controllers placed on or near the character’s joints; and (ii) as a virtual camera that enables users to freely move around the character. Through the touch screen, users can activate/deactivate actions such as selecting an IK controller or pressing animation control buttons placed in a hovering 3D panel. By systematically re-positioning and saving the positions of the IK controllers, different poses can be achieved and, therefore, used to generate a 3D animation.

## CCS CONCEPTS

• **Computing methodologies** → **Animation; Mixed / augmented reality.**

## KEYWORDS

character animation, smartphone, mobile augmented reality

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## 1 INTRODUCTION

Previous studies have explored the potential of posing virtual humanoid characters using performance capture with simple RGB cameras [Cimen et al. 2018] or motion sensing input devices like the Microsoft Kinect [Walther-Franks et al. 2012], but lack the flexibility to animate movements outside the laws of physics. Virtual and Augmented Reality systems with more natural interactions have been introduced in the animation pipeline [Pan and Mitchell 2020], which allow users to use two controllers for interacting with the character’s joints to create poses, however, a Mobile AR version of these types of animation tools is yet to be explored.

In this paper, we present AR-Pose, a mobile AR app for humanoid character posing, where a smartphone is converted into a virtual 3D cursor that can select and manipulate IK handles to articulate a character in AR space. The animator uses a smartphone to freely control a virtual camera to seek for different points of view and, more importantly, to pose a humanoid character by manipulating IK handles of the underlying rig. Several poses can be saved as keyframes, to be then replayed as a smooth animation. This way, by exploring the positional and rotational degrees of freedom (6DoF) of a smartphone, the animator can better grasp the 3D nature of the character’s pose and animation movements without dealing with the limitations of traditional hardware devices such as flat displays, mouse and keyboard.

## 2 INTERFACE AND INTERACTION DESIGN

### 2.1 Calibration Setup

AR-Pose relies on ARCore<sup>1</sup> to detect feature points and set the plane mapping of the 3D animation workspace. Once the plane is mapped, the user taps on the display where they want the character

<sup>1</sup>ARCore - <https://developers.google.com/ar> (Accessed May 7th, 2021)

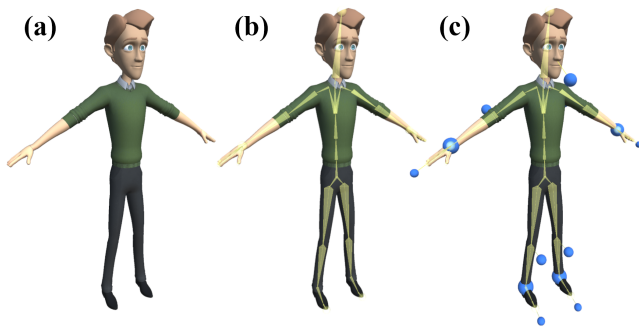
and the control panel to be instantiated, defining the projected location of the scene onto the mapped plane in the real world.

## 2.2 Interaction Design

In order to interact with the virtual elements, a 3D cursor, composed of a virtual sphere connected to a line segment (aka, the pointer), was virtually mounted to a fixed point in camera coordinates, which then translates into a 3D point in real world coordinates.

By default, posing starts with the avatar in A-pose. Interaction with the avatar is based on manipulating 3D spherical handles placed either upon the avatar's joints or near body segment extremities (See Figure 2). The user can move in physical space around the avatar, while maneuvering the smartphone in order to intersect virtual objects. Handle activation occurs whenever the pointer intersects a 3D handle. Once activated, visual feedback is provided to the user in the form of changing the handle's color and its material to wireframe, hence, indicating that the user can activate an action (e.g., selection, adjustment, release) by pressing (i.e., tap and hold) a red button placed in the lower section of the touchscreen, at a thumbs reach.

Four main handles are placed at the end of each major body extremity (left/right wrist, left/right ankle), where each represent the extremity of an IK chain with two bones and a joint. Other nine handles (head, left/right elbow, left/right hand, left/right knee, left/right foot) exist to change the position and rotation of their associated body parts, without altering the state of the extremities of their chain. To manipulate these joints, the user intersects the pointer with one of the handles and moves the smartphone freely while holding down the red button displayed on the touchscreen. The handle selected mirrors the movement of the pointer on real world coordinates, limited by mechanical constrictions of the mapped IK.



**Figure 2: The character model (a), IK rig (b), and IK handles that control the underlying rig (c).**

## 2.3 Save and Replay

Basic but essential animation tools such as saving a pose, reproducing an animation and deleting saved poses can be accessed via a control panel with 3D buttons placed next to the user. Every button has a disabled state, a hovered state (for when the pointer has intersected the button) and a selected state (for when the user presses the touchscreen button when the pointer is hovering an

AR button). Through the control panel, a user can save many poses to a single animation timeline, each saved pose mapped to a time instant 0.4 seconds apart. When the user replays an animation slot, the keyframe technique is applied to generate the animation. The reproduction of the animation relies on the calculation of the inbetween positions between the saved poses.

## 3 DISCUSSION

Since mobile AR enables the smartphone to be tracked in real 3D space, we explored AR-Pose not only for manipulating IK handles to pose/animate characters but also looked into the possibilities of posing characters and larger scales (e.g., posing a humanoid character 50 cm tall). By manipulating the smartphone as a hand-held device, users were able to perform spatial tasks such as selection, adjustment and deselection of 3D handles or moving the virtual camera around the 3D character. When these tasks are performed with AR-Pose they resulted in natural, efficient, engaging and easy to learn interactions.

However, the control flexibility inherent to the smartphone revealed to be inversely proportional to the visualization flexibility in an AR environment since, to interact with the model, the user had to physically approach a point of interest, reducing the field of view and, consequently, lose the general overview of how the movement looks in regards of the entire character model while manipulating a joint. This also leads to attention tunneling. One solution to this limitation would be to give the user the power to change the distance between the pointer and the smartphone, allowing them to interact with the joints at the distance they find more appropriate.

Future work would focus on translating the poses saved in application to external files compatible with animation software like Blender, in order to create the opportunity to the application to not be an isolated animation tool, allowing users to build on the work made inside AR-Pose for the other phases of the animation pipeline (like lighting, cinematography and sound design). Another future direction would consist of finding an ideal scale (e.g., 1:2, 1:1, 2:1) to verify how character size affects task load: a very small scale may lead to minute manipulations and to many close-ups that will drift 3DOF tracking, whereas very large scales may require larger body movements leading to 'Gorilla Arms' effect.

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