**PerSign: Personalized Bangladeshi Sign Letters Synthesis**

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**Figure 1.** An overview of our PerSign. Here, 1 shows the novelty of the work. Top row of 1 indicates the Bangladeshi sign language (BdSL) classification where an image with gesture is classified as the Bengali letter. Middle exhibits the vice versa of the previous one, where symbols of signs are generated using generative adversarial networks (GANs). In contrast, ours (last) generate personalized signs—it reproduces a person’s image with the desired sign for a given letter while keeping the profile—face, dress, etc.—unchanged. 2 shows an abstraction of our working pipeline (see section-1). 3 shows image translation module that takes letter and profile image, and GAN translates the image by learning from our dataset.

**Abstract**

Bangladeshi Sign Language (BdSL)—like other sign languages—is tough to learn for general people, especially when it comes to expressing letters. In this poster, we propose PerSign, a system that can reproduce a person’s image by introducing sign gestures in it. We make this operation “personalized”, which means the generated image keeps the person’s initial image profile—face, skin tone, attire, background—unchanged while altering the hand, palm, and finger positions appropriately. We use an image-to-image translation technique and build a corresponding unique dataset to accomplish the task. We believe the translated image can reduce the communication gap between signers and non-signers without having prior knowledge of BdSL.

**CCS Concepts:** · Human-centered computing → Text input.

**Keywords:** Bangladeshi Sign Language (BdSL), Image-to-Image Translation, Sign Letters Synthesis.

**ACM Reference Format:**  
Mohammad Imrul Jubair, Ali Ahnaf, Tashfiq Nahiyen Khan, Ullash Bhattacharjee, and Tanjila Joti. 2022. PerSign: Personalized Bangladeshi Sign Letters Synthesis. In *The Adjunct Publication of the 35th Annual ACM Symposium on User Interface Software and Systems*.

1 person who uses sign language.
1 Introduction

About 13 million people in Bangladesh are suffering from different degrees of hearing loss, of which 3 million have hearing disability [1]. There are around 1 million using Bangladeshi Sign Language (BdSL) in their everyday life [15]. While communicating with a signer, there are two major tasks for a non-signer: (i) understanding the signs and (ii) expressing the signs. Researchers made impressive contributions to task (i) by developing sign letters' recognition techniques from images (Fig. 1 f). Several works have been proposed for BdSL letters classification via machine learning techniques [4–7, 9, 12, 13, 16]. Task (ii) still has less research attention since it is a difficult process for non-signers. A naive and tiresome approach to expressing signs is to use flash-cards with signs and symbols. Being inspired by that, [14] proposed a system that generates symbols of signs using generative adversarial networks (GANs) [3]. However, their work only produces symbols of signs—which may raise questions regarding the necessity of such a system. Another way is by using animated avatars of signs, i.e. [10]; but there is no such system for BdSL. Moreover, an avatar-based system does not provide a realistic environment for communication.

All the above scenarios inspired us to make task (ii) more realistic yet effortless. Hence, we introduced **PerSign: Personalized Bangladeshi Sign Letters Synthesis**, which converts the image of a user into an image showing signs while keeping the person’s profile unchanged. Fig. 1 e explains the working pipeline of our prototype. A user first uploads their profile photo ($I_p$) only once to our system. The $I_p$ must follow a specific rule of showing hand and palm (as shown in (a)). After that, the user inserts the desired letter (L) to be expressed (e.g. [5] in (a)). Our system converts $I_p$ into $I_L$ by considering L. This can be seen as $I_L ← I_p + L$, where $I_L$ contains the same person in $I_p$ with unchanged face, skin tone, attire, and background (b). In that case, the person does not need any expertise in sign language. We believe, a signer will feel a natural environment if $I_L$ is shown, thus, making the communication more realistic and affectionate.

**Do we really need such a system?**—In order to address this question, we performed a survey on a group of 6 guardians and 11 teachers of deaf children—who were also signers—regarding the necessity of our system. We let participants upload profile images to PerSign and asked them to rate the results on a scale of (1) to (5) according to Likert rating method [11], with (1) being *not necessary at all* and (5) being *very necessary*. Out of total 17 participants, 13 and 3 rated PerSign with (5) and (4) respectively with an average rating of 4.705. Most of the sign language teachers commented that personalized signs are very helpful for general people to get closer to signers, especially when it comes to children.

2 Implementation

We employed the **Generative Adversarial Network** (Fig. 1 d), an unsupervised deep learning technique that automatically learns the patterns from datasets in order for the model to produce a new output [3]. Our problem lies under a sub-domain of GAN which *image-to-image translation* [8] and we adopted *GestureGAN* [17]—a gesture-to-gesture translation method—to implement a prototype system. For this purpose, we built a dataset of images with hand gestures of arbitrary poses, sizes, and backgrounds. Since we needed a paired dataset [$I_p, I_L$] we could not reuse any of the existing unpaired ones. For localizing gestures and appearances, we exploited *OpenPose* [2] to make the skeleton of the hands and face of the images and store the pair of input and output images. We then trained and tested the GestureGAN model with our dataset, and constructed our system’s working prototype. Fig. 2 presents more results of PerSign.

![Figure 2](https://example.com/fig2.png)

**Figure 2.** Result analysis. (a) input profile image. (b) generated image with signs. (c) zoomed view of faces from input (left) and output (right). We can see, that the face is retained.

3 Conclusion and Future work

In this poster, we proposed a framework—**PerSign**—for synthesizing Bangladesh Sign Letters that can be personalized. Through our method, anyone will be able to communicate as a signer without having any expertise in BdSL. We built our own dataset and exploited GestureGAN method to accomplish the task. Our work is still in progress and we gathered comments from the participants during the survey to find areas for improvement. Most of the users recommended applying the technique for a sequence of images to render video for a stream of input letters. We can achieve better results by increasing the number of diverse examples in our dataset. Though our dataset has samples for all BdSL letters, some specific letters need to be treated carefully because of their similarities in patterns. Our final aim is to merge task (i) and (ii) into a single system to provide an *one-stop solution* for two-way communication. Some of the users also suggested extending our work for full gestures, rather than letters only. We are also intent on implementing better GUI with voice input. Last but not the least, we plan to conduct a thorough evaluation from experts and signers. We believe, this poster opens new avenues in sign language for further research.

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2 signs that represent letters only.
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