1 Introduction

SignON focuses on the research and development of a sign language (SL) translation mobile application and an open communications framework. SignON addresses the lack of technology and services for the automatic translation between signed and spoken languages, through an inclusive, human-centric solution which facilitates communication between deaf, hard of hearing (DHH) and hearing individuals.

We present an overview of the status of the project, describing the milestones and the approaches developed to address the challenges and peculiarities of SL machine translation (SLMT).

SLs are the primary means of communication for over 70 million DHH individuals. Despite this, they are rarely included in ongoing developments of natural-language processing (NLP) advancements. Machine translation (MT) research which targets SLs is still in its infancy, due mainly to the lack of data and effective representation of signs (including the lack of a standardized written form for SLs).

Both the low volume of available resources, as well as the linguistic properties of SLs provide challenges for MT. Furthermore, SLs are visual languages, which presents yet another challenge: the recognition and synthesis of a signing human.

2 The SignON approach to SLMT

The objective of the SignON project is MT between signed and spoken languages in all possible combinations, as well as the delivery of this service to the primary user groups: DHH and hearing users.

The project revolves around 4 spoken (English, Spanish, Dutch, Irish) and 5 SLs, (ISL, NGT, VGT, LSE, and BSL —namely Irish, Dutch, Flemish, Spanish and British SL). Addressing this many language pairs and directions on a pair-by-pair basis would require a substantial amount of time and effort, far beyond the scope of the project. SignON employs an MT approach that (i) focuses on processing and understanding individual languages, (ii) employs a common multi-lingual representation (InterL) to facilitate translation and (iii) uses symbolic as well as deep-learning methods for the synthesis of a 3D virtual signer. This approach involves automatic SL and speech recognition (SLR and ASR respectively), NLP, sign and speech synthesis, text generation and, most importantly, representation of utterances in a common frame of reference —an interlingual representation space based on embeddings and/or symbolic structures, the InterL. The complexity and diversity of these processing steps require multi-domain knowledge and expertise. Furthermore, we chose this approach as there are only limited parallel resources available between signed and spoken/written languages. Relying on techniques such as transfer learning, and pre-built NLP models (i.e. mBART (Lewis et al., 2020)) will improve MT performance.

We have built state-of-the-art models and components for SLR, exploiting convolutional...
neural network-, recurrent neural network- and
transformer-based models, natural-language un-
derstanding and MT based on mBART. We are
developing approaches through wordnets and ab-
stract semantic representation and synthesis based
on language specific logical structures for SL, be-
havioral markup language and a 3D avatar render-
ing system.

The ASR component will tune to the use cases
and to the speaker (including atypical speech from
deaf speakers and speakers with cochlear im-
plants). The ASR addresses (i) privacy chal-
lenges (ii) adaption to communicative settings and
(iii) extension to new data and languages. Cur-
rently, English and Dutch are ready; Spanish is
in progress. The transfer learning approach is
adapted for Irish. The ASR works as a web ser-
vice via a secure restful API.

3 SignON application and open
framework

The general architecture (Figure 1) consists of a
mobile application which connects users to the
cloud-based MT platform. The SignON app is the
interface between the user and the SignON frame-
work which handles the internal data flow and pro-
cessing. The framework executes the following
steps. The source message (audio, video or text)
and any relevant metadata coming from the mo-
bile app is processed by an orchestrator which
queues it towards the translation pipeline through
a message broker. A dispatcher subscribed to
the appropriate queue receives the message, invo-
kling the relevant component depending on the type
of input. After the required processing is com-
plete, the message passes to the next stage of the
pipeline until, finally, once the translation tasks
are completed, the output message is produced in
the requested format (text, audio or sign language
avatar). The output is delivered to the app via the
orchestrator. Each component is encapsulated in a
docker container and distributed over different ma-
machines.

The first release of the SignON mobile applica-
tion is due in June 2022, and will then evolve to its
final release at the end of the project (Dec. 2023).
The app will be available as open source and for
free.

4 Societal impact

Along with the technological and academic inno-
vations that come in terms of new models and
methods for SLMT, SignON strives towards having
a large societal impact. Currently we face soci-
etal challenges such as clashes between the views
of DHH and hearing people, with respect to use-
cases, technological importance and communica-
tion needs. We organized two sets of interviews
with deaf participants, an online survey and we
have two round tables planned. Via workshops
we inform both the research and user communities
about the progress of SignON and the state-of-the-
art in SLMT.

5 Progress and next steps

In the first 15 months of this project 8 academic pa-
pers were accepted for publication. These papers
discuss SLR, NLP, SLMT as well as SL repre-
sentations. At the time of writing more than 5 papers
are under review. We have conducted focus group
interviews with VGT, ISL, LSE and NGT signers
as well as public and internal surveys.

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