**CASE TITLE: Fighting Malnutrition in a Changing Climate**

Module: Service Oriented Design, academic year 2023|24
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## Introduction

The context for this case is child healthcare, in particular addressing the effects of *climate change* on *child malnutrition* in the Global South. Especially in the global south, climate change is bringing extreme weather conditions, like droughts and floods, which in turn result in water- and food insecurity, hence worsening malnutrition with deleterious effects, especially in children.
In this context, we recognize various challenges related to healthcare, like early referral and detection of malnutrition, and timely intervention to cure it. In addition, much can be done for prevention, like behaviour change for healthy nutrition in households and pregnant women. Moreover, food security can be addressed by adapting agriculture to climate change, like investing in resistant crops, creating knowledge for local agriculture solutions, and weather prediction.

Software solutions and software-intensive systems can potentially help in all challenges mentioned above. However, due to socio-technical and environmental limitations, especially in the global south, such software must be designed differently than in highly digitalized countries like the Netherlands. Its usability and reliability must be ensured despite low connectivity, variable digital literacy, electricity scarcity, and the limitations of the available computing devices and services.

In the following sections, we zoom into each challenge with special emphasis on the possible support by software.

## Malnutrition detection and intervention

*Health professionals* specialised in child malnutrition in clinics in Uganda, Africa, use software to assess if a child is malnourished. They take pictures of key body parts that are typical indicators, and these are compared with reference data. Unfortunately, malnutrition is often recognised only when it is too late, and the child is visibly starved. Also, taking pictures can be cumbersome, if not impossible. It should be possible to use reference data for early detection, so that children can be referred to a clinic and the interventions can focus on changing the nutritional habits suitable for the possibilities of the child's family.
In this direction, software should support both **detection**, with access to (remote) databases of reference data for case-by-case comparison; and **intervention**, with suggestions for either referral to specialised clinics or identification of suitable diets and suggestions for local food support.

*Figure 1: Screening for Acute Malnutrition with a MUAC tape [1]*

## Malnutrition prevention

*Volunteers* and *medical personnel* should be able to support pregnant women and households in analysing their nutritional habits. Research shows that child malnutrition starts before birth, already during pregnancy [2]. Hence, helping families and future mothers in changing their diets and nutritional habits can contribute to malnutrition prevention.
To this aim, software can help medics in profiling households with malnourished children and suggest changes in diet; but also access knowledge about, for instance, local access to food and medical support.

## Climate change

Droughts and floods significantly worsened the availability of drinkable water and food security.
Software can help *farmers*, for example, in collecting meteorological information so that extreme weather changes impacting agriculture can be predicted; and in providing knowledge about what types of crops are most suitable/resistant to local climate changes.

**Designing Sustainability-aware Software for the Global South**

In general, designing software for the Global South needs specific attention [4,5]. In particular, the described software applications are typically used by *non-technical users* with variable to no digital literacy, like medical personnel or farmers. Further existing devices like mobile phones or tablets are limited in terms of computing resources, typically being recycled old-generation technology. As such, software should be highly usable and efficient by providing clear and essential functionality.

In addition, software is being used in *resource-scarce environments*, e.g., with unreliable connectivity, low quality-of-service, very limited access to electricity. Accordingly, the software should be designed to be usable and reliable anytime anyplace, despite resource scarcity.

*Photometric anthropometry* has been validated to measure body fat percentage in the Netherlands. The method is being piloted in Uganda [3].

**Case Description**

You will design services that support particular usage scenarios based on fighting malnutrition in the global south. Your services will most likely pose requirements on, for instance, the existence of reference data for malnutrition detection, intervention, and prevention.

For the purpose of this case, you may assume that these requirements are satisfied, and that the necessary data exists in the form of data collections. However, you might explore different scenarios regarding the degree of accessibility of such data collections.

The purpose of the services you design is to support a particular usage scenario. You are free to decide on the usage scenario you will support, as long as it addresses at least one of the challenges mentioned in this document, and the collaboration and coordination between multiple individual services. **Usage scenarios** that could be suitable for your project include, but are not limited to:

- Medical support
    - How to support early detection of malnutrition by comparing locally sourced data (e.g. photos) with reference data (remote or local)? How to ensure functionality in case of resource scarcity?
- Medical training
    - How to train volunteers or patients about suitable diets or nutritional behaviour change?
- Farming
    - How to support sustainable farming in unpredictable climate change? How to support families with healthy yet affordable nutritional options?

**References**


[1] UNICEF. (Dec. 2022). Regional Call to Action: Horn of Africa Drought Crisis, Climate Change is here now. UNICEF.

[2] Fall, Caroline HD. "Fetal malnutrition and long-term outcomes." Maternal and Child Nutrition: The First 1,000 Days. Vol. 74. Karger Publishers, 2013. 11-25.

[3] Penders, Bas, et al. "Validating Paediatric Morphometrics: body proportion measurement using photogrammetric anthropometry." Journal of paediatric endocrinology and metabolism 28.11-12 (2015): 1357-1362.

[4] Shahid, S., et al. (2021). Child-Computer Interaction in the Global South: Designing for Children on the Margins. Annual ACM Interaction Design and Children Conference, 655–657.

[5] Arun, C. (2020). AI and the Global South: Designing for Other Worlds. In *The Oxford Handbook of Ethics of AI The Oxford Handbook of Ethics of AI*. Oxford University Press, 588, 606.

## Glossary

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| Resource-scarce environment | In the context of digitalization and the operation of digital solutions, resource scarcity typically refers to the insufficient availability and reliability of the computing resources (e.g., connectivity, cloud provisioning) and electricity. |
| Global South | “The Global South is a term broadly comprises Africa, Latin America and the Caribbean, Asia without Israel, Japan, and South Korea, and Oceania without Australia and New Zealand.” [UNCTAD]<br>Source: https://en.wikipedia.org/wiki/Global_North_and_Global_South |
| Photometric anthropometry | Anthropometry based on photographic images<br>Source: https://en.wikipedia.org/wiki/Anthropometry |
| Participants (TBD) | Health professionals …<br>Medical personnel …<br>Volunteers …<br>Clinic …<br>Data providers … |