UNIVERSITÀ DEGLI STUDI DI TRIESTE

Dipartimento Universitario Clinico di Scienze mediche, chirurgiche e della salute

Laurea Magistrale in Medicina e Chirurgia

Cost-effectiveness of the italian screening protocol for international adoptees

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"Every single minute matters,
every single child matters,
every single childhood matters."

- Kailash Satyarthi, Indian children's rights activist

Abstract (Italian)

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Abstract

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And lastly, to myself, for always believing that, even when your heart's lost all its hope, after dawn there will be sunshine.

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Abbreviations

VBA **V**isual **B**asic for **A**pplications

Chapter 1

Introduction

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1.1 Objectives

Being a rather open-ended project, i.e. a project in which there is no strict and well-defined set of software requirement specifications, the objectives of the development have been purposefully kept wide and general, as to reflect the idea that the project could follow an exploratory approach.

Nonetheless, there are still some guidelines that have been followed from the beginning to the end of the project:

- The project shall result in a working prototype of a Virtual Reality application.
- The application shall allow the handling of CFD data; in particular, it shall provide:
  - visualization of the data,
  - interaction with the data,
  - some basic forms of manipulation of the data.

- The application shall allow the import of data from ParaView.
- The application shall run compatibly at least on Windows (version 7 or greater), and optionally on Linux.
- The application shall support a HTC Vive kit.
- The code should be designed to be maintainable, flexible and expandable.
- The application should be easy to use, being it aimed at CFD scientists with little to no prior VR experience.

In Section 1.2 these objectives will be discussed in light of the work done.

1.2 Project Management

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1.2.1 Time management

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1.2.2 Versioning and productivity tools

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1.2.2.1 Github

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1.2.2.2 Waffle

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Chapter 2

Materials and Methods

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2.1.1 VBA expressions

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All VBA expression can be found in Appendix A at page 23.

2.1.2 Cut-off values

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2.1.2.1 Haemoglobin

This was a little prick.

2.1.2.2 MCV

This was ANOTHER little prick.

2.1.2.3 Circulating Iron

This was easy.

2.1.2.4 Vitamin D

Vitamin D is healthy. 25OH...

2.2 Literature Review

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2.3 Technologies Used

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2.3.1 ParaView and VTK

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2.3.1.1 Virtual Reality Capabilities in ParaView

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2.3.2 Unity

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2.3.2.1 Object behaviors in Unity

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2.3.2.2 Virtual Reality Capabilities in Unity

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2.3.3 ParaUnity

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Chapter 3

Results

3.1 Introduction

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3.1.1 Why Unity?

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3.2 Application Architecture

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3.2.1 Environment

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Pellentesque nibh metus, suscipit a scelerisque sit amet, rhoncus et lectus. Mauris eget erat rutrum, euismod massa id, maximus mauris. Nulla maximus, ex sit amet lacinia consequat, enim ante mollis dui, sit amet tincidunt massa felis id magna. Aenean gravida ante nec volutpat rutrum. Cras eget ullamcorper leo. Curabitur eu volutpat tellus. Integer nec ornare sapien. Fusce ipsum justo, interdum quis libero a, mattis tristique velit. Phasellus rhoncus lorem non ultrices luctus.

Chapter 4

Discussion

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4.1 Final system architecture

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Pellentesque nibh metus, suscipit a scelerisque sit amet, rhoncus et lectus. Mauris eget erat rutrum, euismod massa id, maximus mauris. Nulla maximus, ex sit amet lacinia consequat, enim ante mollis dui, sit amet tincidunt massa felis id magna. Aenean gravida ante nec volutpat rutrum. Cras eget ullamcorper leo. Curabitur eu volutpat tellus. Integer nec ornare sapien. Fusce ipsum justo, interdum quis libero a, mattis tristique velit. Phasellus rhoncus lorem non ultrices luctus.

4.2 Objectives achieved

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Pellentesque nibh metus, suscipit a scelerisque sit amet, rhoncus et lectus. Mauris eget erat rutrum, euismod massa id, maximus mauris. Nulla maximus, ex sit amet lacinia consequat, enim ante mollis dui, sit amet tincidunt massa felis id magna. Aenean gravida ante nec volutpat rutrum. Cras eget ullamcorper leo. Curabitur eu volutpat tellus. Integer nec ornare sapien. Fusce ipsum justo, interdum quis libero a, mattis tristique velit. Phasellus rhoncus lorem non ultrices luctus.

4.3 Future work

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Pellentesque nibh metus, suscipit a scelerisque sit amet, rhoncus et lectus. Mauris eget erat rutrum, euismod massa id, maximus mauris. Nulla maximus, ex sit amet lacinia consequat, enim ante mollis dui, sit amet tincidunt massa felis id magna. Aenean gravida ante nec volutpat rutrum. Cras eget ullamcorper leo. Curabitur eu volutpat tellus. Integer nec ornare sapien. Fusce ipsum justo, interdum quis libero a, mattis tristique velit. Phasellus rhoncus lorem non ultrices luctus.

Chapter 5

How to Do

This is all I know on LaTex up to now.

5.1 Including Sections and Subsections

This is my first section.

5.1.1 I like myself

I'm nice.

5.1.2 but I'm weird

but fun.

5.1.2.1 LOST OF FUN!

Writing writing and writing.

5.1.2.2 I'm calm and shit

I write stuff in subsubsections.

And lastly this is new and amazing PARAGRAPH: You can write whatever you want and it's pretty cool and new. I still like subsubsections more.

5.2 Including references and citations

This is pretty simple to cite: developed as open-source C++ software by Rudolf Biczok [23]. We'll learn more about this as we go.

5.2.1 Referencing images and tables!

So you can see figure 5.1 at page 21. AMAZING
OR you can also see the table 5.1 at page 21!

5.2.2 Referencing chapters and subchapters

You can also ref chapters, as Chapter Results 3.

5.2.3 Using footnotes

Let's try this out.[1] And another one to see if it is progressive and shit.[2]

I'll try now to "place them manually". This is were the sign is.[3]
Somewhere else in the text. I insert what it contains.

[1] This is my first footnote.
[2] CAREFUL! Don't leave any spaces before the command or they will be rendered.
[3] This is my footnote!

5.3 Including quotes

This is how a quote looks.

> From an evolutionary perspective, virtual reality is seen as a way to overcome limitations of standard human-computer interfaces; from a revolutionary perspective, virtual reality technology opens the door to new types of applications that exploit the possibilities offered by presence simulation.

And also in text quotes: "[by] immersing the user in the solution, virtual reality reveals the spatially complex structures in computational science in a way that makes them easy to understand and study".

And dots...

5.4 Including URLs

We can include `https://github.com/vrcranfield/UnityApplication`.

5.5 Including code

The following code is written by Lorenzo:

```
=IF(
   OR(
      E68 = "Russia";
      E68 = "Albania";
      E68 = "Bulgaria";
      E68 = "Ungheria";
      E68 = "Ucraina";
      E68 = "Moldavia";
      E68 = "Romania"
   );
   "Europa dell'Est";
   IF(
      OR(
         E68 = "Burkina Faso";
         E68 = "Etiopia";
         E68 = "Costa d'Avorio";
         E68 = "Congo";
         E68 = "Guinea Bissau";
         E68 = "Africa";
         E68 = "Ghana";
         E68 = "Benin"
      );
      "Africa";
      IF(
         OR(
            E68 = "Colombia";
            E68 = "Brasile";
            E68 = "Guatemala";
            E68 = "Peru";
            E68 = "Costa Rica"
         );
         "America del Sud";
         IF(
            OR(
               E68 = "Armenia";
               E68 = "India";
               E68 = "Cina";
               E68 = "Vietnam";
               E68 = "Sri Lanka";
               E68 = "Siberia";
               E68 = "Nepal";
               E68 = "Filippine"
            );
            "Asia";
            ""
         )
      )
   )
)
```

5.6 Formatting Text

This is BOLD *This is ITALIC* This is SANS SERIF `This is TRUE TYPE`
In this sentence THIS IS TINY. THIS WHOLE SENCE IS TINY.

I go back to normal.

Then I can go for large, or Large, or Larger, or Huge and even HUGE.

5.7 Including bulleted list

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam quam tellus, venenatis a consectetur non, pretium ac nunc. Nullam eu tellus sed augue laoreet scelerisque.

- The first item of your list
- The second item of your list
- The third item of your list

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam quam tellus, venenatis a consectetur non, pretium ac nunc. Nullam eu tellus sed augue laoreet scelerisque. Curabitur efficitur, dolor ut pretium fermentum, nisi enim pulvinar nunc, non bibendum urna odio nec neque. Cras tellus turpis, posuere in dictum vitae, vestibulum quis velit.

1. The first item of your list
2. The second item of your list
3. The third item of your list

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam quam tellus, venenatis a consectetur non, pretium ac nunc. Nullam eu tellus sed augue laoreet scelerisque. Curabitur efficitur, dolor ut pretium fermentum, nisi enim pulvinar nunc, non bibendum urna odio nec neque. Cras tellus turpis, posuere in dictum vitae, vestibulum quis velit.

a) The first item of your list

b) The second item of your list

c) The third item of your list

5.8 Including Figures

Orci varius natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Nam vulputate finibus malesuada. Praesent at egestas turpis. Vivamus vitae tellus malesuada, laoreet ex ac, venenatis est. Aliquam dictum tincidunt libero, cursus posuere arcu sodales non. In sed metus sit amet arcu vestibulum mollis ut vel nibh. Nam non velit tortor. Integer ac sapien a purus porta convallis. In vestibulum aliquam nunc vitae faucibus. Etiam tristique iaculis orci, vel aliquam felis accumsan et. Nulla ultricies, nisl eu malesuada lobortis, ante metus faucibus libero, vitae blandit odio enim sit amet tortor.

5.9 Including Tables

Orci varius natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Nam vulputate finibus malesuada. Praesent at egestas turpis. Vivamus vitae tellus malesuada, laoreet ex ac, venenatis est. Aliquam dictum tincidunt libero, cursus posuere arcu sodales non. In sed metus sit amet arcu vestibulum mollis ut vel nibh. Nam non velit tortor. Integer ac sapien a purus porta convallis. In vestibulum aliquam nunc vitae faucibus. Etiam tristique iaculis orci, vel aliquam

FIGURE 5.1: Living room as I imagine it

Source: Photo courtesy of HTC

felis accumsan et. Nulla ultricies, nisl eu malesuada lobortis, ante metus faucibus libero, vitae blandit odio enim sit amet tortor.

Day	Max Temp	Min Temp
Mon	20	13
Tue	22	14
Wed	23	12
Thurs	25	13
Fri	18	7
Sat	15	13
Sun	20	13

(A) First Week

Day	Max Temp	Min Temp
Mon	17	11
Tue	16	10
Wed	14	8
Thurs	12	5
Fri	15	7
Sat	16	12
Sun	15	9

(B) Second Week

TABLE 5.1: Max and min temps recorded in the first two weeks of July

ParaView			
VTK			
OpenGL	**MPI**	**OpenVR**	**Etc.**

TABLE 5.2: ParaView-VTK Architecture (simplified)

Appendix A

Data set elaboration: VBA expressions

This appendix provides all the VBA code used in this thesis to elaborate the data set. Further information can be found throughout the thesis, especially in Section 2.1 at page 6.

A.1 Age (in months)

This VBA expression checks the Age (in months) column and, if it's not empty, it divides it's value by 12, rounding it down, just as age works.
The `ROUNDOWN` function was needed in order to avoid overestimating children's age.

```
=IF(
   C2 <> "";
   ROUNDDOWN(
      C2 / 12;
      0
   );
   ""
)
```

A.2 Geographic area of origin

To further understand how geographic origin influenced the results of our screening program, every nation was grouped up in 4 major continents are areas with the following excel expression.

```
=IF(
   OR(
      E2 = "Russia";
      E2 = "Albania";
      E2 = "Bulgaria";
      E2 = "Hungary";
      E2 = "Ukraine";
      E2 = "Moldavia";
      E2 = "Romania"
   );
   "Eastern Europe";
   IF(
      OR(
         E2 = "Burkina Faso";
         E2 = "Ethiopia";
         E2 = "Ivory Coast";
         E2 = "Congo";
         E2 = "Guinea Bissau";
         E2 = "Africa";
         E2 = "Ghana";
         E2 = "Benin"
      );
      "Africa";
      IF(
         OR(
            E2 = "Colombia";
            E2 = "Brazil";
            E2 = "Guatemala";
            E2 = "Peru";
            E2 = "Costa Rica"
         );
         "South America";
         IF(
            OR(
               E2 = "Armenia";
               E2 = "India";
               E2 = "China";
               E2 = "Vietnam";
               E2 = "Sri Lanka";
               E2 = "Siberia";
```

```
                E2 = "Nepal";
                E2 = "Philippines"
            );
            "Asia";
            ""
        )
    )
)
```

A.3 Pathological values

The data set contained numerical values for many laboratory analyses. Cut-off values for these results were established via the most recent literature review, as explained in Sections 2.1.2. In the following sections, the code used to establish which ones where pathological and which were not is displayed and shortly explained.

A.3.1 Weight and height

These parameters, since they had already been converted to percentile values, were easily implement with the following simple VBA expression:

```
=IF(
   H2 <> "";
   IF(
      H2 <= 10;
      1;
      0
   );
   ""
)
```

A.3.2 Haemoglobin

Hemoglobin required a more complicated and sophisticated expression, in order to be stratified, because hemoglobin pathological cut-offs depend on various factors, as described in Section 2.1.2.1. Moreover mild, moderate and severe anemia had to be separated in order to properly evaluate the child's health status; each one had an arbitrary values of 1 (*mild*), 2 (*moderate*) or 3 (*severe*) associated to it.

```
=IF(
   L2 <> "";
   IF(
      AND(
         C2 >= 6;
         C2 < 60
      );
      IF(
         L2 >= 11;
         0;
         IF(
            AND(
               L2 < 11;
               L2 >= 10
            );
            1;
            IF(
               AND(
                  L2 < 10;
                  L2 >= 7
               );
               2;
               3
            )
         )
      );
      IF(
         AND(
            C2 >= 60;
            C2 < 132
         );
         IF(
            L2 >= 11,5;
            0;
            IF(
               AND(
                  L2 < 11,5;
```

```
                    L2 >= 11
                );
                1;
                IF(
                    AND(
                        L2 < 11;
                        L2 >= 8
                    );
                    2;
                    3
                )
            )
        );
        IF(
            AND(
                C2 >= 132;
                C2 < 168
            );
            IF(
                L2 >= 12;
                0;
                IF(
                    AND(
                        L2 < 12;
                        L2 >= 11
                    );
                    1;
                    IF(
                        AND(
                            L2 < 11;
                            L2 >= 8
                        );
                        2;
                        3
                    )
                )
            )
        )
    );
    ""
)
```

A.3.3 MCV

As just described for haemglobin, MCV required more complicated techniques in order to be stratified, because of its variability (through age, sex, ecc...), as described in Section 2.1.2.2. Moreover, boolean results couldn't be accepted for this parameter, so arbitrary values were used to appropriately identify microcytic (*1*) and macrocytic (*2*) anemias.

```
=IF(
   N2 <> "";
   IF(
      B2 = "F";
      IF(
         AND(
            C2 >= 0;
            C2 < 60
         );
         IF(
            N2 > 85;
            2;
            IF(
               AND(
                  N2 <= 85;
                  N2 >= 69
               );
               0;
               1
            )
         );
         IF(
            AND(
               C2 >= 60;
               C2 < 120
            );
            IF(
               N2 > 89;
               2;
               IF(
                  AND(
                     N2 <= 89;
                     N2 >= 75
                  );
                  0;
                  1
               )
```

```
            );
            IF(
               AND(
                  C2 >= 120;
                  C2 < 168
               );
               IF(
                  N2 > 92;
                  2;
                  IF(
                     AND(
                        N2 <= 92;
                        N2 >= 78
                     );
                     0;
                     1
                  )
               )
            )
         )
      );
      IF(
         B2 = "M";
         IF(
            AND(
               C2 >= 0;
               C2 < 60
            );
            IF(
               N2 > 85;
               2;
               IF(
                  AND(
                     N2 <= 85;
                     N2 >= 71
                  );
                  0;
                  1
               )
            );
            IF(
               AND(
                  C2 >= 60;
                  C2 < 120
               );
               IF(
                  N2 > 88;
                  2;
                  IF(
```

```
                    AND(
                        N2 <= 88;
                        N2 >= 76
                    );
                    0;
                    1
                )
            );
            IF(
                AND(
                    C2 >= 120;
                    C2 < 168
                );
                IF(
                    N2 > 90;
                    2;
                    IF(
                        AND(
                            N2 <= 90;
                            N2 >= 76
                        );
                        0;
                        1
                    )
                )
            )
        )
    );
    ""
)
```

A.3.4 Circulating iron

The following VBA expression was used to establish whether circulating iron values were insufficient.

```
=IF(
   P2 <> "";
   IF(
      AND(
         P2 >= 16;
         P2 <= 129
      );
      0;
      1
   );
   ""
)
```

A.3.5 Ferritin

The following VBA expression was used to identify pathological ferritin values, these were, again, stratified for mild (*1*), moderate (*2*) and severe (*3*) deficiency.

```
=IF(
   R2 <> "";
   IF(
      R2 >= 20;
      0;
      IF(
         AND(
            R2 < 20;
            R2 >= 15
         );
         1;
         IF(
            AND(
               R2 < 15;
               R2 >= 10
            );
            2;
            IF(
               R2 < 10;
               3
            )
         )
      )
   );
   ""
```

```
)
```

A.3.6 Vitamin D

The following VBA expression was used to establish whether Vitamin D (serum *25-hydroxycholecalciferol*) values were insufficient (*1*), deficient (*2*) or severly deficient (*3*). The predictive choice for this marker is explained at Section 2.1.2.4.

```
=IF(
   AA2 <> "";
   IF(
      AA2 >= 50;
      0;
      IF(
         AND(
            AA2 < 50;
            AA2 >= 25
         );
         1;
         IF(
            AND(
               AA2 < 25;
               AA2 >= 10
            );
            2;
            IF(
               AA2 < 10;
               3
            )
         )
      )
   );
   ""
)
```

Appendix B

Code of the Unity Application

In this section the code of the scripts of the Unity Application is provided. The appendix is divided in sections, each containing the source code of one class, in alphabetical order.

B.1 AnimationManager

Stuff maybe goes here?

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