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Article

Determining risk of diabetes and cardiovascular diseases occurrence utilizing data via smart devices

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Keywords: keyword 1; keyword 2; keyword 3 (List three to ten pertinent keywords specific to the article; yet reasonably common within the subject discipline.)

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1. Introduction

The introduction should [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16] briefly place the study in a broad context and highlight why it is important. It should define the purpose of the work and its significance. The current state of the research field should be reviewed carefully and key publications cited. Please highlight controversial and diverging hypotheses when necessary. Finally, briefly mention the main aim of the work and highlight the principal conclusions. As far as possible, please keep the introduction comprehensible to scientists outside your particular field of research. Citing a journal paper. Now citing a book reference or other reference types . Please use the command for the following MDPI journals, which use author–date citation: Administrative Sciences, Arts, Econometrics, Economies, Genealogy, Humanities, IJFS, Journal of Intelligence, Journalism and Media, JRFM, Languages, Laws, Religions, Risks, Social Sciences, Literature.

2. Related Work

As mentioned before, the applications of Statistical Analysis and Machine Learning in healthcare and more specifically in diabetes condition have demonstrated a steady rise in the last two decades, since the development of corresponding programming frameworks have enabled the easy storage, collection, processing, analysis of the massively

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available data quantity and employment of statistical and Machine Learning models [17–19]. Regarding diabetes research field, the literature deals with the identification of diabetic people, early or long term (2-10 years) prognosis and diabetes complications prediction or identification.

Our literature review is focused on relatively new research articles or systematic reviews which are related with the context of our article e.g prediction of diabetes mellitus or prediabetes utilizing demographic, anthropometric, biometric, laboratory, nutritional, medical history, etc. data as input features. The first mathematical approaches over diabetes issue consisted of statistical risk scores exploiting questionnaires filled by waves from the participants. Some of the famous ones risk scores are Leicester Risk Assessment Score[20] developed by Leicester University and FINDRISC [21] developed by University of Helsinki. The former utilizing a Logistic Regression model, take into account age, ethnicity, sex, first degree family history of diabetes, antihypertensive therapy or history of hypertension, waist circumference and BMI to predict current impaired glucose regulation or diabetes mellitus, achieving an AUC metric of 72% and the latter -also exploited Logistic Regression- uses gender, age, BMI, use of blood pressure medication, history of high blood glucose, physical activity, daily consumption of vegetables, fruits or berries and family history of diabetes to predict a 10-year development achieving an AUC metric of 86%. We can observe at a first glance two variances of diabetes studies. The Leicster Risk aims to identify the current health condition, while FINDRISC tries to predict a long term prevalence. There are also numerous researches that deal with deep learning and more specifically with image recognition for the classification of diabetic retinopathy, which is a typical complication and very well studied in the research field, using images from eye bulb as input [2,12]. Another diabetes complications studies utilizing Machine Learning and Deep Learning include neuropathy and nephropathy [2,12]. Apart from classification problems there are also regression methods which are exploited for the prediction of Fasting Plasma Glycose or HbA1c levels, i.e. biomarkers that are the best indicators of abnormal glycose regulation and consequently diabetes mellitus presence [2,3,12].

Delving more into literature that is more relevant with the purpose of this study we can observe an adequate quantity of high quality articles which will help to understand a principal methodology in order to identify or predict diabetes development. Next, the chosen papers will be clustered based on their purpose, their key methodologies will be in a more detailed context described and also each other compared for advantages and disadvantages.

The current-state detection of diabetes is studied in [3,4]. In [4] the dataset used is PIMA from UCI repository [22] with target variable the diabetes presence. First, during the feature selection procedure, methods like information gain, gain ratio, gini index,ANOVA, χ^2 test, an extension of Relief, correlation, fast correlation and filter subset evaluation where employed. Glucose levels, BMI, diabetes pedigree function and age was identified as the best features on average from the aforementioned techniques. Then, a variety of models was trained and tested on the different feature subsets derived from the feature selection techniques using 10 fold cross validation. The models probed were GAMBoost, regularized logistic regression, penalized multinomial regression, Bayesian generalized linear model, penalized logistic regression, generalized linear model, sparse distance weighted discrimination, generalized boosted regression model and Naive Bayes. Generalized additive model using LOESS yeld the best AUC 85.36% and achieved Sensitivity, Specificity 86%, 60%.

3. Materials and Methods

Materials and Methods should be described with sufficient details to allow others to replicate and build on published results. Please note that publication of your manuscript implicates that you must make all materials, data, computer code, and protocols associated with the publication available to readers. Please disclose at the submission stage any restrictions on the availability of materials or information. New methods and protocols

should be described in detail while well-established methods can be briefly described and appropriately cited.

Research manuscripts reporting large datasets that are deposited in a publicly available database should specify where the data have been deposited and provide the relevant accession numbers. If the accession numbers have not yet been obtained at the time of submission, please state that they will be provided during review. They must be provided prior to publication.

Interventionary studies involving animals or humans, and other studies require ethical approval must list the authority that provided approval and the corresponding ethical approval code.

This is an example of a quote.

4. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

4.1. Subsection

4.1.1. Subsubsection

Bulleted lists look like this:

- First bullet;
- Second bullet;
- Third bullet.

Numbered lists can be added as follows:

1. First item;
2. Second item;
3. Third item.

The text continues here.

4.2. Figures, Tables and Schemes

All figures and tables should be cited in the main text as Figure 1, Table 1, Table 2, etc.

Figure 1. This is a figure. Schemes follow the same formatting. If there are multiple panels, they should be listed as: (**a**) Description of what is contained in the first panel. (**b**) Description of what is contained in the second panel. Figures should be placed in the main text near to the first time they are cited. A caption on a single line should be centered.

Table 1. This is a table caption. Tables should be placed in the main text near to the first time they are cited.

Title 1	Title 2	Title 3
Entry 1	Data	Data
Entry 2	Data	Data

Table 2. This is a wide table.

Title 1	Title 2	Title 3	Title 4
Entry 1	Data	Data	Data
Entry 2	Data	Data	Data [1]

[1] This is a table footnote.

Text.

Text.

4.3. Formatting of Mathematical Components

This is the example 1 of equation:

$$a = 1, \tag{1}$$

the text following an equation need not be a new paragraph. Please punctuate equations as regular text.

This is the example 2 of equation:

$$a = b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q + r + s + t + u + v + w + x + y + z \tag{2}$$

Figure 2. This is a wide figure.

Please punctuate equations as regular text. Theorem-type environments (including propositions, lemmas, corollaries etc.) can be formatted as follows:

Theorem 1. *Example text of a theorem.*

The text continues here. Proofs must be formatted as follows:

Proof of Theorem 1. Text of the proof. Note that the phrase "of Theorem 1" is optional if it is clear which theorem is being referred to. □

The text continues here.

5. Discussion

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

6. Conclusions

This section is not mandatory, but can be added to the manuscript if the discussion is unusually long or complex.

7. Patents

This section is not mandatory, but may be added if there are patents resulting from the work reported in this manuscript.

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Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
TLA	Three letter acronym
LD	Linear dichroism

Appendix A

Appendix A.1

The appendix is an optional section that can contain details and data supplemental to the main text—for example, explanations of experimental details that would disrupt the flow of the main text but nonetheless remain crucial to understanding and reproducing the research shown; figures of replicates for experiments of which representative data are shown in the main text can be added here if brief, or as Supplementary Data. Mathematical proofs of results not central to the paper can be added as an appendix.

Table A1. This is a table caption.

Title 1	Title 2	Title 3
Entry 1	Data	Data
Entry 2	Data	Data

Appendix B

All appendix sections must be cited in the main text. In the appendices, Figures, Tables, etc. should be labeled, starting with "A"—e.g., Figure A1, Figure A2, etc.

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