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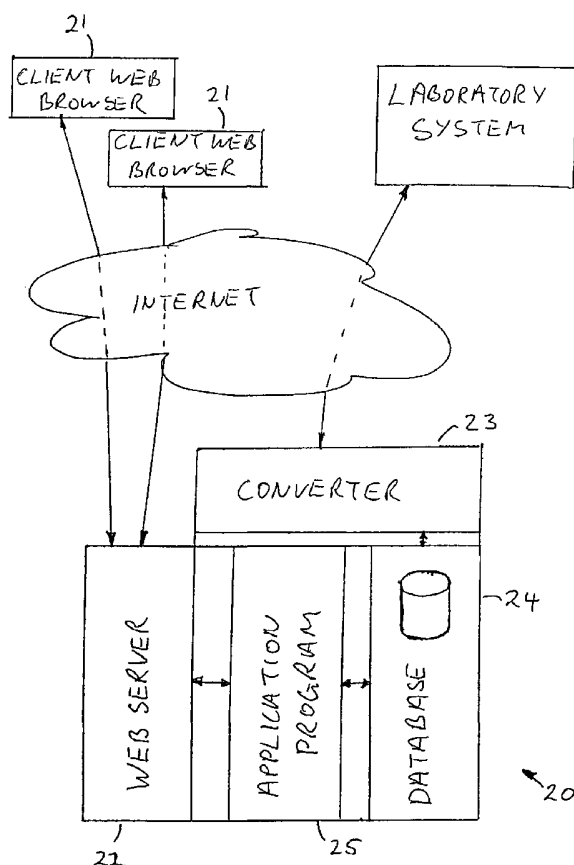
(57) Abstract: A centralised system for measuring biological age receives patient bio-marker measurements from remote locations, e.g. via the Internet. This enables a biological age or ages for a patient to be calculated against the many measurements stored for other patients. Weights can be assigned to bio-markers on the database depending on how precise a measurement of biological age they provide. The system can also determine the rate of biological aging for a patient.

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IMPROVED BIOLOGICAL AGE MEASUREMENT

The present invention relates to anti-aging. More specifically, the invention relates to a system for calculating combined biological age.

The concept of biological age is well known. It is well recognised that certain physiological and medical aspects of the human body change during the aging process. It is also known that the rate of change of these aspects can be increased or decreased in a particular individual through a range of treatments.

The particular physiological and medical aspects that change throughout the aging process are known as aging (or "ageing") bio-markers. By measuring a number of these biomarkers for a particular patient, it is possible to determine the patient's biological age separately from their chronological age.

One system which does this is known as H-Scan and this has been used in a number of clinics worldwide. The H-Scan system comprises special equipment for measuring the bio-markers and the measurements for the particular bio-markers are provided directly from the patient; no medical professionals are required. (For example, no blood tests or other tests requiring specialist medical equipment or laboratory analysis are taken.) In the H-Scan system, the patient carries out twelve simple tests. (An example of one of these tests might be a measurement of reaction speed where the patient is, for example, required to respond to a sudden sound or light as quickly as possible.) The system combines

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those twelve results into an appropriate measure of combined biological age. That biological age is then communicated to the patient.

The known system described above is useful because it is an independent system which can produce a measure of biological age for the patient independently and quickly. However, there are a number of disadvantages associated with this known system and these are outlined below.

Firstly, only twelve tests are used and the use of so few tests obviously limits the accuracy of the combined biological age which is calculated. In addition, the twelve tests are the same for every patient.

Secondly, none of the twelve tests involve any laboratory measurements, but are simply measurements that can be obtained from the patient alone at the special equipment. Whilst this means that the patient can obtain a measure of combined biological age relatively quickly and easily, it does mean that the accuracy of the combined biological age is limited at the outset, since no laboratory tests are included. This is especially the case since a measure of reaction speed, for example, is more susceptible to error than a measure of a particular hormone in the blood, for example.

Thirdly, each time the patient carries out the twelve tests to produce a measure of combined biological age is an independent session. Patient data is not stored

or carried over from one session to the next, so it is not possible to assess how the combined biological age for that patient has changed from one session to the next. Accordingly, no assessment can be made of either the rate of aging of a particular patient or the expected age of the patient in future.

Finally, when the combined biological age is communicated to the patient, no information on how that value of combined biological age was calculated is indicated. In addition, no subsequent information or advice on suitable treatment is given by the system.

An object of the invention is to provide a system which substantially overcomes or mitigates the problems with the known systems described above. a further object of the invention is to provide a system for calculating biological age which substantially overcomes or mitigates the problems with the known systems described above.

Various aspects of the invention are set out in the appended claims.

By way of example, embodiments of the invention will be described with reference to the accompanying drawings, of which:

Figure 1 is a schematic diagram showing the processing involved in the overall system of the invention, and

Figure 2 is a schematic diagram showing the principal software modules.

As will be seen in Figure 1, the overall system involves the following processing phases:

1) Data capture (1)

2) Database processing (2)

3) Statistical calculations (3)

4) Reporting and visualisation (4)

5) Statistical analysis (13)

The architectural framework used to put the system into effect has preferably the following characteristics:

1.   Scalability. The system should be designed to cope with increasing amounts of data. This is particularly important since one of the advantages of the system is that patient data is kept indefinitely, so there will inevitably be a large increase in the amount of data stored.

2.   Flexibility. The system should be designed to rapidly change to respond to new requirements and to modify formulae in the light of experience whilst retaining data integrity.

3.   Security. The system should be able to ensure that all patient data, formulae and software is secure from external threat, disaster and corruption.

4.   Integrity. There should be ongoing validation of clinic input to protect
      against error and deliberate falsification.

5.   Manageability. It is preferable that no local installation of software is
      required, that minimal administration is required, that new versions and
      updates are easy to implement and access and that no local training is
      required.

In initial use, the system can be relatively straightforward. Only a small number of

clinics and medical practitioners will be involved and, inevitably, at the outset

there will be little or no local support. At this stage, the system simply comprises

data capture, calculation of combined biological age and sophisticated reporting.

However, it is envisaged that the solution will expand significantly with use, to

accommodate thousands of clinics and medical practitioners and tens of

thousands of patients. At that time, the solution may comprise links to treatment

options, drug details and training programmes. The calculation of combined

biological age may also be modified to incorporate more factors into the

calculation and hence to provide a better result for combined biological age. This

is described in more detail later.

In order to support a global solution with little or no local support, the system is

preferably accessed via a standard web-browser.

The steps of the system are now described, with reference to Figure 1.

Data capture 1

In the preferred embodiment of the invention four types of information 5, 6, 7, 8 are captured. The first three types of information 5, 6, 7 comprise information about patients. The fourth 8 is for a central data maintenance function. The types of information captured are:

1. Bio-markers 5. As already mentioned these are measures that have a direct relationship to the aging process and therefore contribute to the calculation of combined biological age.

2. General Health Indicators 6. These are measures that may be of interest to the medical practitioners/clinics or to the patients, but do not have a direct relationship to the aging process.

3. Patient Information 7. This comprises straightforward patient data such as address, age, height etc. These data will not be used directly in the basic system in a calculation of combined biological age, but, in an advanced version of the system are factored in to the calculation as described later.

4. Central data maintenance function 8. Set up information relating to clinics and users is input to the system so that the system is ready for use to calculate biological ages. Set up information regarding the various biological age measures (together with their relative weights)

described below are also input to the system. Further information relating to suggested treatment and drugs is also input.

As mentioned above, a bio-marker 5 is a measure which has a direct relationship to chronological age. Some measures have a very obvious relationship to the aging process (for example the ability to hear sounds at high frequencies declines with age) and can immediately be classed as bio-markers. Some, on the other hand, have a less clear relationship to the aging process and it may not be immediately clear whether or not they should be classed as a bio-marker.

Accordingly, selection of a range of good bio-markers is not straightforward and preferably four factors are considered when assessing whether a particular measure should be given bio-marker status.

The first factor to be considered is the quality of the age relationship described by the available data. The curve defining the mean score for each age group is assessed together with the likely variance from individual scores. Some such age relationships will initially be unacceptable as bio-markers. These include data sources having a severely restricted age range (since there are difficulties and risks with extrapolating data with such a restricted age range); curves with a high variance/standard deviation (the curve does not realistically represent the data since there is much variation from one piece of data to the next); a flat or nearly flat slope across all or some of the range (there is little or no relationship to age);

and curves such as parabolas and inverted slopes where there are two possible biological ages for each data value given. These are simply examples of measures that would not initially be classed as bio-markers because the quality of the age relationship described by the available data is poor.

The second factor to be considered is the validity of the sample for the age-norm data with consideration to the general population. Or, is the data representative of the general population?

The third factor is the group to whom the available data is applicable (e.g. gender/ethnicity restrictions). a measure which is only applicable to Caucasian men of certain ages for example will, at first instance, be ruled out as a bio-marker, or alternatively given a lower weighting.

The fourth factor is the availability of suitable medical advice and guidance in relation to the bio-marker, e.g. which treatments can reduce the corresponding biological age.

Those measures which are not allocated bio-marker status may nonetheless be of interest to the patient and/or clinic/medical practitioner; these will be classed as general health indicators 6 rather than bio-markers 5, or as candidate bio-markers for which data is collected so that at some future time when the data

indicates that bio-marker status is justified they can be so converted in the system.

Examples of candidate bio-markers are given in the attached annex A.

Bio-markers are captured from the patient in one of three ways – (i) via standard medical equipment (5a) e.g. blood pressure meter, (ii) via samples of blood or urine etc. for subsequent analysis (also 5a), or (iii) via computer with appropriate software tests (e.g. measuring reaction speeds) (5b). There may also be tests which require specialist medical equipment. In case (ii), a medical practitioner may be needed and subsequent laboratory analysis may take place. In case (iii), it may be possible for the patient to take the measurement alone and enter the data directly (for example via a standard web-browser) or it may be necessary for a medical practitioner to interpret the measurement and enter the data.

In case (ii) , there are several ways in which the laboratory results can be inputted to the system. The first option 501 (and the one that is most likely in the early stages of the system) is for the laboratory to provide the data in its own particular format. This data will then be converted so that it can be entered into the database. The drawback of this option is that there are a large number of formats in which the data could be presented by the laboratory and these will all separately need to be interpreted and entered into the system. The second option 502 (which will be used once the system is more established) is for the

laboratory to enter the data directly onto the system. This is obviously preferable to the first option but will involve more work in the laboratory in order to understand and use the system. The third option 503 (which will be used only once the system is well established) is for the system to work in tandem with its own laboratory facilities which enter the data directly, so that no external input is actually required. Of course, the three options 501, 502 and 503 may be used separately or in conjunction with one another.

The date and time of capture is recorded along with the particular bio-marker. This is important because the data is kept indefinitely and also because the time of day or month may be relevant to certain bio-markers.

A typical data capture for a particular patient would obtain between 70 and 120 bio-markers.

As mentioned above, general health indicators 6 are measures which might be of interest to the patient and/or medical professional/clinic but do not have a direct relationship to the aging process and therefore cannot be used as bio-markers. These may, for example, be measures that have "failed" the bio-marker tests outlined above.

Examples of general health indicators are given in Annex B.

Although general health indicators are not included in the calculation of a combined biological age they are of interest to patients and practitioners and so are included in reports generated by the system. Of course in time, with the accumulation of data in the system it will be evident that some general health indicator is related to age and so then that measure could be adopted as a bio-marker.

Most general health indicators will be specific measures within pre-determined ranges. However, there may also be some yes/no options, selections from lists and linked questions. There may be some compulsory questions and it is envisaged that on-line help will be available.

A typical data capture for a particular patient would obtain between 20 and 30 general health indicators.

As mentioned above, patient information 7 comprises straightforward patient data such as address, age, height etc. These data will not be used directly in a calculation of combined biological age. However, in the advanced version of the system, an improved value of combined biological age may be calculated if patient information is taken into account. There are two ways in which this may be relevant. These examples are described later.

A typical data capture for a particular patient would obtain between 20 and 30 items of patient information.

As mentioned above, the central database maintenance function 8 comprises information for the overall running of the central database and also comprises information about clinics, treatment and drugs. This is useful when the patient is being advised on appropriate treatment and drugs once they have been informed of their biological age.

Database processing 2

An additional objective of the system of the present invention is to accumulate patient data participating in anti-aging programs globally, in one central database 9. The scientific community will be able to access this database 9 for ongoing analysis and to define and refine appropriate treatments.

From a database perspective, there are four functions to be performed:

1) Measurement data from clinics, doctors and patients need to be accurately and consistently captured over time. All data will be held indefinitely and therefore total volumes as well as data for each individual patient will increase over time. Consistent performance is required, with clinics achieving promised service levels, even at peak times.

2) The calculation of biological age takes all bio-marker information for a patient for a specific date and uses these to calculate biological age. The answer to the calculation needs to be returned to the clinic within a short period of time after data capture is complete.

3) Reports, whether textual or by visualisation, should include both current and historical data for an individual patient.

4) The scientific community will have certain access to the database for statistical analysis 13.

Statistical Calculation 3

The first step of the statistical calculation is to calculate a biological age 10_i for each individual bio-marker i. This is done by comparing the bio-marker value with the results for the average person. Thus, if the patient has a reaction speed which is the same as the reaction speed of a typical 45 year old, the patient will be said to have a biological age of 45 for reaction speed. Thus each individual bio-marker i is assigned a particular biological age 10_i.

The simplest approach to obtain a biological age 10_i for a particular bio-marker i is simply to read off a known graph of bio-marker versus age. In practice, however, as mentioned above, there will be other factors to incorporate when determining the biological age for a particular bio-marker. For example, the racial

origin, gender, age or other details of the patient may be significant. Thus, in an advanced version of the system, the calculation will incorporate items of patient information, where relevant as well as the value of the bio-marker itself, as is explained later.

These individual biological ages are used to both calculate a patient's combined biological age and to determine appropriate treatment programmes to address areas of concern. Therefore, using the maximum number of bio-markers is advantageous.

The second step of the statistical calculation is to assign a weighting f_i for each individual biological age. There are two factors which may be relevant when assigning a weighting f_i for a particular biological age but only one of these is actually taken into account in the preferred embodiment of the invention when a weighting is assigned, as will be described below.

The first possible factor is the importance of the particular bio-marker. For example, it is clear that the biological age of the heart and lungs is more important than the biological age associated with the hair loss shown by the patient, when considering the overall health of the patient. However, although the relative importance is clear in that case, in other cases, it is not so clear and the relative importance of two bio-markers becomes a rather subjective matter. Thus,

this factor is not taken into account in the preferred embodiment of the system

when the weightings of the particular bio-markers are assigned.

The second possible factor is the accuracy and reliability of the data, and this is

taken into account in the preferred embodiment . Ideally, the system would

include for each bio-marker data for patients between the ages of 25 and 80 that

is relevant to both genders, all ethnic origins etc. and which has a steep slope

with a small deviation. However, in practice, this will be the case for only a very

few of the bio-markers. Those bio-markers will be assigned a high weighting, and

bio-markers for which the data is not so high quality will be assigned a lower

weighting. In general the weights are predetermined by the system administrator

in accordance with this criterion, but the process may be automated.

Of course a system which takes into account both importance and accuracy

weights is possible.

The final step of the statistical calculation is to combine the individual biological

ages 10_i with their assigned weightings into a combined biological age 11,

preferably the weighted average of the individual biological ages.

$$A = \frac{\sum_i w_i a_i}{\sum_i w_i}$$, where a is the combined biological age, a_i are the individual

biological ages, and w_i are their respective weights.

One of the key advantages of the present system, is that the calculation does not require values for all bio-markers. For example, if the system is established to be able to calculate a combined biological age 11 from 100 individual biological ages calculated for 100 individual bio-markers, the system is still able to calculate a combined biological age 11 if a smaller number of individual biological ages is available, for example if results for certain bio-markers are unavailable and hence no biological age can be calculated for those bio-markers. The number of bio-markers acceptable for the calculation, may be given a pre-determined lower limit. For example, in a system designed to incorporate 100 individual biological ages, the system may be set to require at least 80 individual biological ages (i.e. from 80 bio-markers) in order to calculate a combined biological age 11. However, which those particular 80 bio-markers are is not determined, so that the system can deal with values for any 80 or more bio-markers out of the selected 100 bio-markers. In order to do this, that bio-marker result (i) may be completely omitted from the calculation (i.e. from both the sums in the weighted average formula given above for the combined biological age), or (ii) the average result for that bio-marker may be inputted instead; but there may be other methods for coping with less than a full set of data. The missing or derived values will be flagged when the information is reported. This system is advantageous, since it may be difficult to obtain data for certain bio-markers for certain patients, but a combined biological age can be calculated nevertheless. Clearly, the more bio-markers that are available, the more accurate the resultant combined biological age.

As noted above the calculation of the combined biological age can be improved by taking into account patient information. Two examples of how this may be done are as follows. An example of a first way is this: if it is known that men from a particular area have a higher than average result for one particular bio-marker, then, if combined biological age is being calculated for a man from that area, it would be preferable to compare his bio-marker result with results from other men in the area, rather than the average for the general population. Thus, in that example, it is of interest to know where the patient is from so that that particular piece of patient information can be factored into the calculation of combined biological age. An example of a second way is this: say a particular bio-marker is limited to women of a certain ethnic origin and of a certain age range and the patient is in fact a woman of that ethnicity and within that age range, it would be preferable to assign a higher weighting to that bio-marker for that patient than would be assigned for another patient who does not fall within that ethnicity and age range. The weighting will be used when combined biological age is calculated and this will be explained in more detail below.

Reporting and visualisation

A final phase of the processing of the system is the communication of the individual biological ages 10 and the combined biological age 11 to the patient,

medical practitioner and clinic P. The data is presented in the form of a visible

presentation 12 to the patient on a return trip to the clinic.

One way in which this can be done is for an image of the human body to be

presented on the patient interface. On that image, areas of high biological age

(relative to chronological age) will be indicated and areas of low biological age

(relative to chronological age) will also be indicated. In addition, or instead, the

patient will be presented with a scale on which the calculated biological ages are

shown ranging from those which show a low biological age to those which show

a high biological age. The system is also preferably arranged to provide the

patient with advice on how to treat a small number of the bio-markers (for

example those which show the highest biological age) in order to reduce the

biological age for those bio-markers and hence reduce the patient's combined

biological age.

Statistical Analysis

With use, the central database will provide data on thousands of bio-markers for

thousands of patients. It will therefore be an extremely valuable tool for scientists,

researchers, medical practitioners and clinics, as well as third-party commercial

organisations such as insurance companies and pharmaceutical companies.

Each time a patient uses the system, their bio-marker data will be entered onto

the system thereby increasing the amount of data stored and also contributing to

the accuracy of the bio-marker data.

The storage of data in the database over time means that the combined

biological age of the patient at one session can be compared to the combined

biological age of the patient at the next session. In addition, the individual

biological ages for certain bio-markers at one session can be compared with the

individual biological ages for those bio-markers at the next session. Thus, the

rate of aging of a particular patient can be assessed and preferably the system is

arranged to include those figures in the reports to patents and practitioners.

In addition, the data can be extrapolated to predict how the combined biological

age or individual biological age will change over the next period of time. This may

be done simply using the rate of aging or by some more complicated method

such a curve fitting.

If treatment is undertaken by the patient specifically to treat certain bio-markers

which showed high biological ages, it will be possible to see what effect that

treatment is having on the rate of aging both for that particular bio-marker and

also for the combined biological age. It will also be possible, once the system is

established, to determine, from the data accumulated, the effect of certain

treatments on the rate of aging; this will be done by a comparison with patient

data which is already held on the database.

The system can potentially evolve into a complete anti-aging clinic solution.

Developments will include:

- Definition of new bio-markers

- More convenient methods of data capture

- Incorporation of more factors (e.g. items of patient information) into the

  calculation of combined biological age

- An increasing amount of data in the database resulting in more accurate

  and consistent calculations of biological age.

Computer System Architecture

Referring now to Figure 2, for ease of installation the system comprises a central

server 20 with which users such as patients and practitioners communicate using

a web browser 21 via the Internet. The central server therefore preferably

comprises a web server 22 (such as Microsoft Internet Information Server) for

compiling web pages for viewing by the users and for receiving the data they

input, a data conversion module 23 for receiving electronic laboratory analysis

reports, a database 24 and associated server software (such as SybaseIQ or

Microsoft SQL Server) recording patient test results and optionally the calculated

biological ages (which could of course be reproduced at any time from the test

results), and an application program 25 for carrying out the processing described

above in relation to Figure 1, thus embodying the logic of the system, and

coordinating the operation of the other modules of Figure 2 to do that. The

various servers and modules may be located on a single server computer or may

be distributed across more than one server computer located at one or more

sites.

Other architectures may be used to implement the invention, but a centralised

database provides the advantages of making it easy to access patient records

from any location over a long period of time and of allowing statistical analysis of

data for a very large number of patients.

Annex a – Candidate Bio-markers

17-hydroxycorticosteroids

17-ketosteroid/17-hydroxycorticosteroid ratio (17-KS/17-OHCS)

11-deoxy-17-ketosteroid

Acid Phosphatase

Acid Secretion

Activin A

Albumin

Albumin / Globulin Ratio

Alkaline Phosphatase

Amylase

Amylase clearance / Creatinine clearance

Androstenedione

Ankle Brachial Index

Apolipoprotein (A)

Apolipoprotein (B)

Aqueous Flare Intensity

Arcus Senilis

Ascorbic Acid

Arterial pulse wave velocity - Aorta

Arterial pulse wave velocity - Radial carotid

Arterial pulse wave velocity - radial brachial

arterial pulse wave velocity - brachial - ulna

arterial pulse wave velocity - carotid - femoral

arterial pulse wave velocity - femoral - poplital

Auditory Acuity Hearing test - 1000 Hz

Auditory Acuity Hearing test - 125 Hz

Auditory Acuity Hearing test - 1500 Hz

Auditory Acuity Hearing test - 2000 Hz

Auditory Acuity Hearing test - 250 Hz

Auditory Acuity Hearing test - 3000 Hz

Auditory Acuity Hearing test - 4000 Hz

Auditory Acuity Hearing test - 500 Hz

Auditory Acuity Hearing test - 5000 Hz

Auditory Acuity Hearing test - 6000 Hz

Auditory Acuity Hearing test - 750 Hz

Auditory Acuity Hearing test - 8000 Hz

Baldness - rating, none = 0 complete = 5

Baldness - rating, none = 0 complete = 3

Baldness - degree of loss

Baroreflex sensitivity

Basal Metabolic Rate (BMR)

BGP (OsteoCalcin - Bone gla Protein)

Bilirubin - Total
            - Direct
            - Indirect

Body fat %

Body flexibility - anteflexion - degrees

Body flexibility - anteflexion - centimeters

Body flexibility - retroflexion

Body flexibility - side flexion

Body Mass Index (BMI)

Bone density

BUN (Blood Urea Nitrogen)

Calcium serum

Carbonic Anhydrase

Cardiac output

Caries index - total no of decayed, missing or filled teeth

CEA (Carcino Embryonic Antogin)

Ceruloplasmin

Cholesterol - Total
                  - Low Density Lipoproteins (LDL)
                  - High Density Lipoproteins (HDL)

Coenzyme Q10

Collagen N Telopeptide

Colour Word Test

Concentration tests - Landolt

Contrast sensitivity

Copper / Ceruloplasmin Ratio

Copper / Zinc Ratio - hair

Copper / Zinc Ratio - serum

Copper serum

Coronary Artery Calcium

Cortisol

Creatinine

Creatinine clearance

Critical Flicker Fusion (CFF)

CRP-High sensitivity C Reactive Protein

Dark Adaptation

Dexamethasone Suppression Test

DHEA - Dehydroepiandrosterone (Urine)

DHEA S - Dehydroepiandrosterone Sulphate

Diastolic blood pressure

Digit Symbol

Dihydrotestosterone

D-xylose

Electroencephalogram

Erythrocyte sedimentation rate

Estradiol

Estriol (unconjugated)

Estrogen

Estrone

Face Wrinkles

Fat-free weight

Fatty Acids - total

Ferritin

FEV1 - Forced Expired Volume

Fibrinogen

Finger Dexterity - O'Connor Pegboard test

Finger Dexterity - Purdue Pegboard test

FVC - Forced Vital Capacity

Free PSA index

Free Testosterone index

Fructosamine

FSH - Follicle Stimulating Hormone

FSH - Follicle Stimulating Hormone - Urine 24 hour

GGTP - Gamma Glutamyl Transpeptidase

Glare

Globulin

Glucose

Glutathione   - reduced
                        - reduced (measured)

GM1 (Gangliosides)

Hair grayness none = 0, complete = 5

Hair grayness none = 0 , complete = 3

Hair grayness - % of grayness

Handgrip strength dominant hand in kg

HDL (high density Lipoproteins)

Heart Rate - maximum beats per min

Hemoglobin A1C

Hemoglobin level

Homocysteine

IGF BP3 - Insulin Growth Factor Binding Protein-3

IGF-1 - Insulin Growth Factor (Growth Hormone)

IGF-1 / IGF BP3

Immunoglobulin - IgG

Immunoglobulin - IgA

Immunoglobulin- IgM

Incidental Memory

Inhibin B

Insulin

Interleukin 6

Interleukin 6 / Bone Density

Interleukin 6 / Insulin

Lactate

Lactate after exercise

LDH (Lactate Dyhydrogense)

LDL (low density lipoproteins)

Lecithin Cholesterol Ratio

LH - Luteinizing Hormone

LH - Luteinizing Hormone - Urine 24 hour

Lipase

Lipoprotein(a)

Magnesium intracellular

Maximum oxygen uptake - Litres per min

Maximum oxygen uptake - ml kg min

Melatonin

Memory tests

Monoamine Oxidase B

MVV_1 (Maximum Voluntary Ventilation)

Near point of vision - centimetres

Near point of vision - diopters

Nerve Conduction Velocity

Norepinephrine - plasma
                               - urine

OGTT - Oral glucose tolerance test - after 1 hour

OGTT - Oral glucose tolerance test after 2 hours

Osteoprotegerin

Periodontal index - degree of tooth disease

Peroxides (Blood)

Peroxides AQ UR

Phospholipids

Phytohemagglutinin

Pitch Ceiling

pO2 - pressure of oxygen

Potassium intracellular

Potassium / fat-free weight ratio

Potassium / sodium ratio

Progesterone

Prolactin

PSA - Prostate Specific Antigen (Free)

PSA - Prostate Specific Antigen (Total)

Pulse Pressure

Pupil Size (diameter mm)

RBC Red Blood Count

Reaction tests

Red blood cell osmotic fragility

Renal Plasma Flow

Resting Metabolic Rate (RMR)

Serotonin
    - Serotonin 5-Hydroxytryptamine (5-HT)
    - Serotonin 5-Hydroxyindoleacetic acid (5-HIAA)

SGOT - Serum Glutamic Oxaloacetic Transaminase (AST)

SGPT - Serum Glutamic Pyruvate Transaminase (ALT)

SHBG (sex homone binding globulin)

Skin Elasticity

Skin-fold thickness

Smell Identification Test

Spinlattice Relaxation Time

static balance (1) - Stand on one leg

static balance (2) - Bio-mechanical force platform

Systolic blood pressure

T3 - Triiodothyronine (FREE)

T3 - Triiodothyronine (TOTAL)

T4 - Thyroxine (FREE)

T4 - Thyroxine (TOTAL)

Tapping Rate - Hand Tally Counter

Tapping Rate - GRC Test

Taste threshold

Testosterone (free)

Testosterone (total)

Thymulin

Thymopoietin

Total lipids

Total protein

Triglycerides

TSH - Thyroid Stimulating Hormone

Uric Acid

Visual Acuity - distance

Visual Acuity - near

Waist / hip ratio

Zinc Serum

17- Ketosteroid

Androstenediol Glucuronide

Apolipoprotein A-1/Apolipoprotein B Ratio

Blood Pressure-Pulse Pressure

Blood Pressure-Diastolic

Blood Pressure-Systolic

Blood Urea Nitrogen (BUN)/Creatinine Ratio

Carbon Dioxide

Calcium

Chloride

Coronary Risk Ratio

Cholesterol Low Density Lipoproteins (LDL)/Cholesterol
        High Density Lipoproteins (HDL) Ratio

Handgrip strength average

Handgrip strength weaker hand

Height

Hemotocrit

Hip measurement

Potassium serum

Pregnanediol

Pregnanetriol

Pulse Rate after exercise

Testesterone Binding to Sex Hormone Binding Capacity (SHBG)

Total Iron Binding Capacity (TIBC)

Unsaturated Iron Binding Capacity (UIBC)

Weight

Annex B – General Health Indicators

Aluminum

Arsenic

Ascorbate(vit c)

Basophils %

Cadmium

Carotene, alpha

Carotene, beta

Chloride

Chromium

Cobalt

Complete blood count - with white cell differential

Cystine

Eosinophils %

Folic acid

Germanium

Iodine

Iron

Lead

Lutein

Lymphocytes %

Manganese

Mch - Mean Corpuscular Hemoglobin

Mchc - Mean Corpuscular Hemoglobin Concentration

Mcv - Mean Corpuscular Volume

Mercury

Molybdenum

Monocytes %

Mucin

Neutrophils %

Nickel

Occult blood (stool guiaiac test)

Orac (total)

Oxalate

Phosphate

Platelet count

Protein, ur 24 hr

Rdw - Red Cell Distribution Width

Retinol

Retinyl palmitate

Selenium

Silver

Sodium

Strontium

Sulphur

Tin

Tocopherol,alpha

Tocopherol,delta

Tocopherol,gamma

Uranium

Urea, ur 24 hr

Vanadium

Vitamin b12

Wbc - White Blood Cells

Zeaxanthin**

CLAIMS:

1. A system comprising:

a database for recording patient bio-marker measurements,

means for receiving into the database patient bio-marker measurements

that have been transmitted to the system in electronic form from a remote

location.

2. A system as claimed in claim 1 comprising means for generating web pages

suitable for users to enter the said patient bio-marker measurements and for

storing that data so entered into the database.

3. A system as claimed in claim 1 or claim 2 comprising a converter for receiving

patient bio-marker measurements in a format that is not native to the system and

converting that data and storing it in the database.

4. A system as claimed in any preceding claim comprising means for calculating

from a bio-marker measurement for a patient a corresponding biological age.

5. A system as claimed in claim 4 comprising means for calculating a combined

biological age from a set of biological ages for a patient derived from a

corresponding set of bio-marker measurements for the patient.

6. A system as claimed in claim 5 wherein the means for calculating the combined biological age is arranged to weight the biological ages in the combination calculated.

7. A system as claimed in claim 6 wherein the means for calculating the combined biological age calculates that as the weighted average of the said biological ages for the patient.

8. A system as claimed in claim 6 or claim 7 wherein the weights given to the biological ages are related to the precision or accuracy of the biological ages.

9. A system as claimed in claim 8 wherein a weight is determined from measurements in the database of the corresponding bio-marker for a plurality of patients.

10. A system as claimed in claim 9 arranged to redetermine the said weight from time to time as more patient bio-marker measurements are added to the database.

11. A system as claimed in any one of claims 6 to 10 wherein the weight is related to the importance to a patient's health of the corresponding bio-marker.

12. A system as claimed in any one of claims 6 to 11 wherein a biological age for a patient is based on measurements of the corresponding bio-marker for a

particular population, whether that population comprises patients for whom such data has been collected by the system or otherwise, and wherein the weight for that biological age is adjusted for the patient according to whether the patient is similar or not, or according to the degree of similarity, to the members of that population according to some defined criteria.

13. A system as claimed in any one of claims 4 to 12 wherein the means for calculating a biological age is arranged, when calculating a biological age for a particular patient, to select from the database measurements of the corresponding bio-marker for patients who are similar to the particular patient according to some defined criteria and to base its calculation of the biological age on those selected measurements.

14. A system as claimed in any preceding claim comprising a measurement software module that measures a particular bio-marker for a patient by measuring responses input by the patient to a computer in response to a stimulus presented at the computer by the module.

15. A system as claimed in any preceding claim comprising means for generating a report about a patient based on their bio-marker measurements.

16. A system as claimed in claim 15 wherein the report generated comprises a visualisation comprising a map of the body indicating biological ages in relation to the relevant part of the body.

17. A system as claimed in claim 15 or claim 16 wherein the report generated comprises a scale on which biological ages for a patient are arranged in value order.

18. A system as claimed in any one of claims 15 to 17 wherein the report comprises anti-aging treatment advice based on biological ages calculated for the patient.

19. A system as claimed in any one of claims 5 to 18, comprising means for receiving into the database patient measurements for candidate bio-markers wherein the means for calculating a combined biological age does not take these measurements into account until the status of those candidate bio-markers is changed to being an actual bio-marker.

20. A system as claimed in any one of claims 5 to 19, wherein the means for calculating the combined biological age is arranged to calculate the combined biological age from a sub-set of the said set of biological ages.

21. A system as claimed in any one of claims 5 to 20 wherein the means for receiving patient biomarker measurements is capable of recording sets of biomarker measurements for a patient made at different points in time, the system further comprising means for calculating the rate of aging from the values of combined biological age for a patient at those points in time.

22. A system as claimed in any one of claims 4 to 21 wherein the means for receiving patient biomarker measurements is capable of recording sets of biomarker measurements for a patient made at different points in time, the system further comprising means for calculating the rate of aging from the values of a particular biological age for a patient at those points in time.

23. A system as claimed in any preceding claim comprising means for calculating a prediction of a patient's biological age based on measurements of bio-markers for that patient.

24. A system as claimed in claim 23, wherein the prediction is based on measurements of bio-markers for the patient made at different points in time.

25. A system as claimed in claim 23, wherein the prediction is based on one or more bio-marker measurements for the patient made at one particular time and a rate of aging for some population.

26. A system as claimed in any one of claims 23 to 25, wherein the prediction is based on a rate of aging for some population.

27. An anti aging system as claimed in claim 26, wherein the population is taken from the said database.

28. A system as claimed in claim 26 or claim 27 wherein the population on which the prediction is based is selected on the basis of information about the patient for whom the prediction is made.

29. A system as claimed in any one of claims 23 to 28 wherein said prediction takes into account a proposed treatment for the patient.

30. A system as claimed in claim 29 comprising means for comparing predictions of the patient's biological age that are with and without taking into account the proposed treatment.

31. A system as claimed in any one of claims 23 to 30, wherein the said biological age predicted is a biological age for an individual bio-marker.

32. A system as claimed in any one of claims 23 to 30, wherein the said biological age predicted is a combined biological age for a plurality of bio-markers.

33. A system as claimed in any preceding claim arranged to allow the addition to the system of further bio-markers.

34. A system comprising:

a database for recording patient bio-marker measurements,

means for receiving into the database patient bio-marker measurements for a patient made at different points in time,

means for calculating a biological age value for different times, from the patient biomarker measurements, and

means for calculating the rate of aging from those biological age values.

35. A system as claimed in claim 34 wherein the biological age value is calculated from measurements for an individual bio-marker.

36. A system as claimed in claim 34 wherein the biological age value is a combined biological age for a plurality of bio-markers.

37. A system comprising:

means for receiving patient bio-marker measurements,

means for calculating from a bio-marker measurement for a patient a

corresponding biological age, and

means for calculating a combined biological age from a set of said

biological ages,

wherein the means for calculating the combined biological age is arranged

to calculate the combined biological age from a sub-set of the said set of

biological ages.

38. A system comprising:

means for receiving patient bio-marker measurements,

means for calculating from a bio-marker measurement for a patient a

corresponding biological age, and

means for calculating a combined biological age from a set of said

biological ages,

wherein the means for calculating the combined biological age is arranged

to weight the biological ages in the combination calculated, the weights given to

the biological ages being related to the precision or accuracy of the biological

ages.

39. A system as claimed in claim 38 wherein a weight is determined from measurements in the database of the corresponding bio-marker for a plurality of patients.

40. A system as claimed in claim 39 arranged to redetermine the said weight from time to time as more patient bio-marker measurements are added to the database.

41. A system as claimed in any one of claims 38 to 40 wherein the weight is related to the importance to a patient's health of the corresponding bio-marker.

42. A system as claimed in any one of claims 38 to 41 wherein a biological age for a patient is based on measurements of the corresponding bio-marker for a particular population, whether that population comprises patients for whom such data has been collected by the system or otherwise, and wherein the weight for that biological age is adjusted for the patient according to whether the patient is similar or not, or according to the degree of similarity, to the members of that population according to some defined criteria.

43. A system comprising:

> means for receiving patient bio-marker measurements, and
>
> means for calculating from a bio-marker measurement for a patient a

corresponding biological age,

> wherein the means for calculating a biological age is arranged, when

calculating a biological age for a particular patient, to select from a database

measurements of the corresponding bio-marker for patients who are similar to

the particular patient according to some defined criteria and to base its

calculation of the biological age on those selected measurements.

44. A system as claimed in any one of claims 38 to 42 and as in claim 43.

45. A system comprising means for calculating a prediction of a patient's

biological age based on measurements of bio-markers for that patient.

46. A system as claimed in claim 45, wherein the prediction is based on

measurements of bio-markers for the patient made at different times.

47. A system as claimed in claim 45, wherein the prediction is based on one or

more bio-marker measurements for the patient made at one particular time and a

rate of aging for some population.

48. A system as claimed in any one of claims 45 to 47, wherein the prediction is based on a rate of aging for some population.

49. An anti aging system as claimed in claim 48, wherein the system comprises a database for patient biomarker measurements, and the said population is taken from the said database.

50. A system as claimed in claim 48 or claim 49 wherein the population on which the prediction is based is selected on the basis of information about the patient for whom the prediction is made.
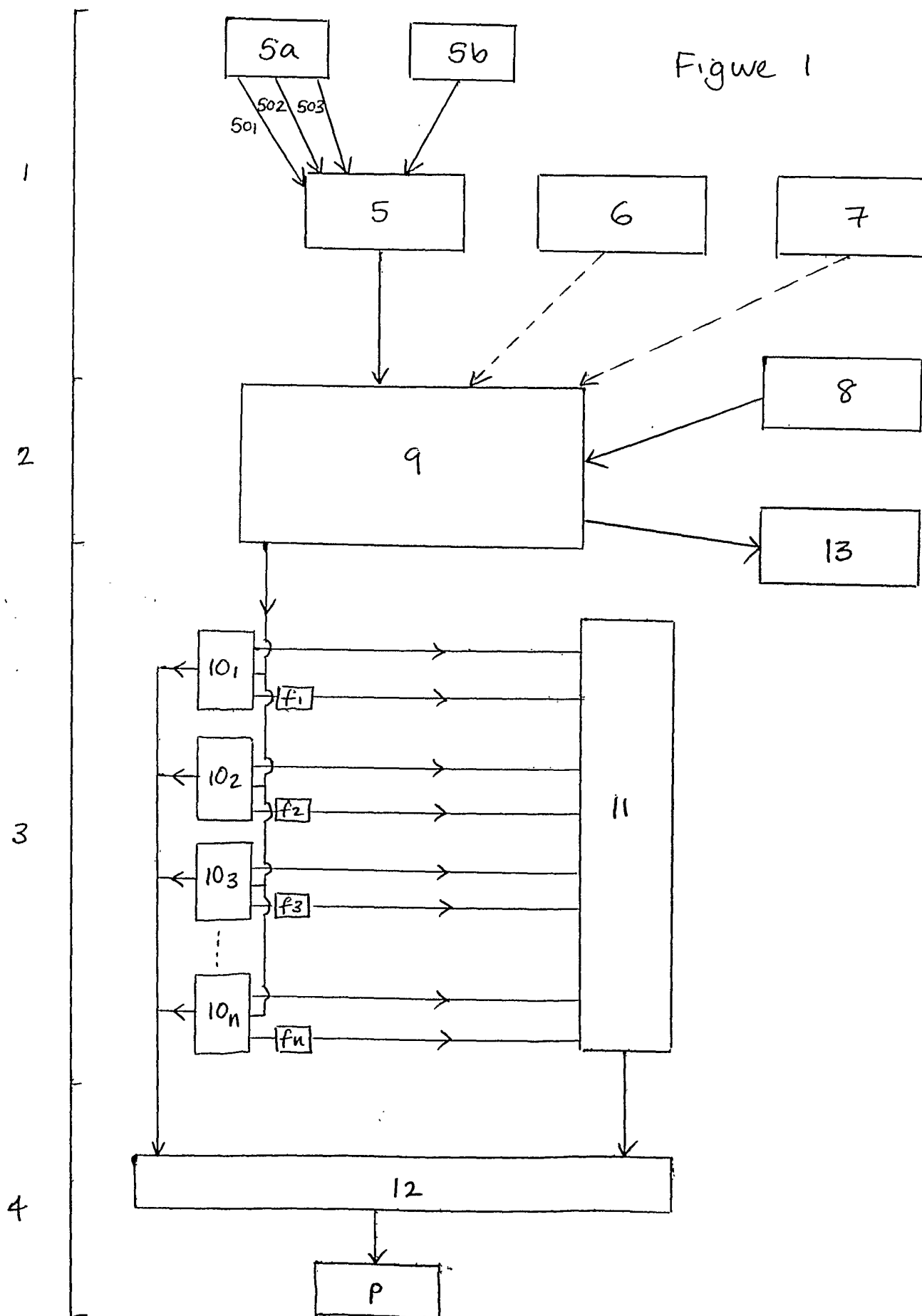
51. A system as claimed in any one of claims 45 to 50 wherein said prediction takes into account a proposed treatment for the patient.

52. A system as claimed in claim 51 comprising means for comparing predictions of the patient's biological age that are with and without taking into account the proposed treatment.

53. A system as claimed in any one of claims 45 to 52, wherein the said biological age predicted is a biological age for an individual bio-marker.

54. A system as claimed in any one of claims 45 to 53, wherein the said

biological age predicted is a combined biological age for a plurality of bio-

markers.

55. A system as claimed in any one of claims 45 to 54 and as in any one of

claims 34 to 36.

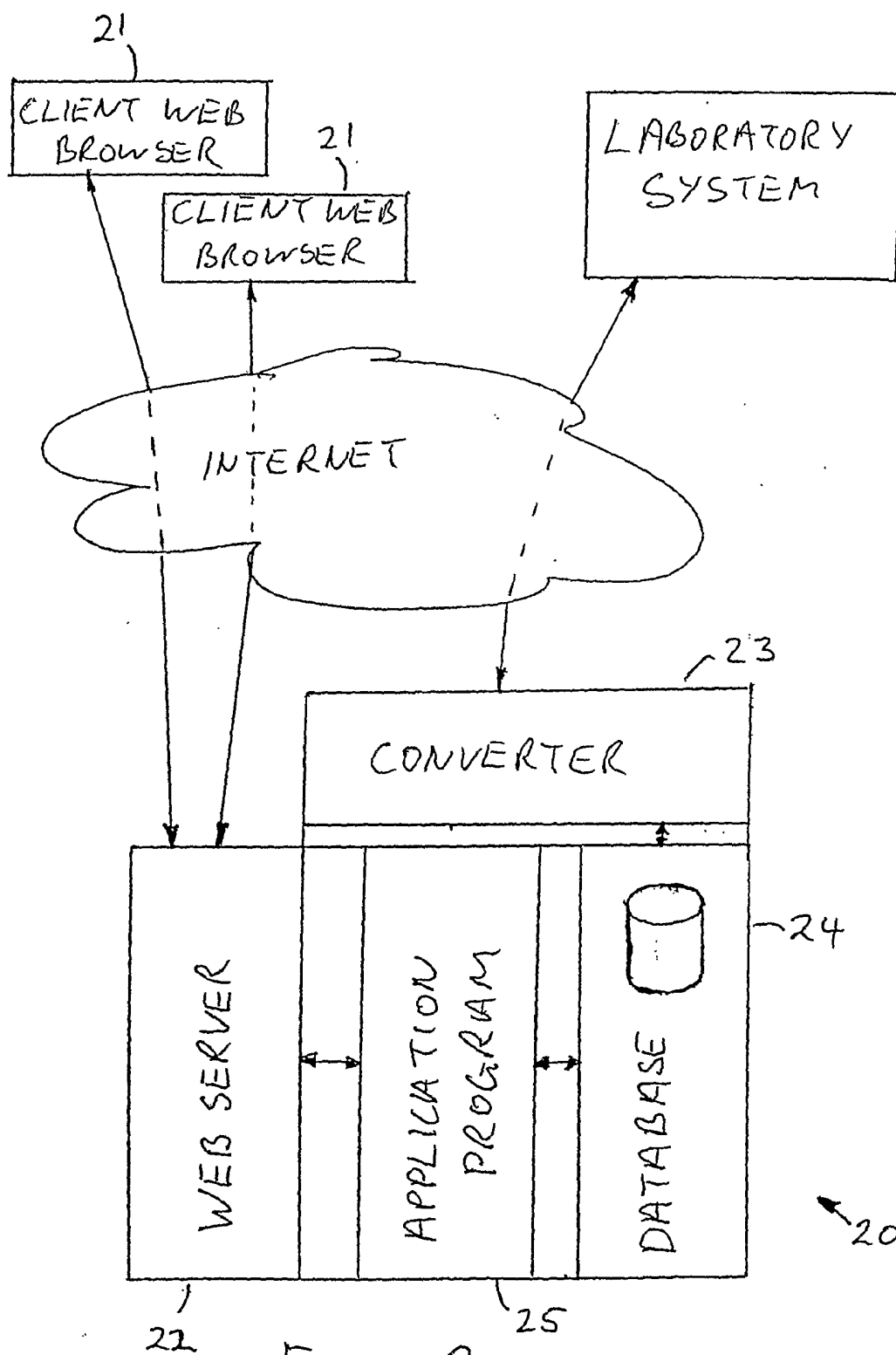56.   A system as claimed in any preceding claim which is an anti-aging system.

Figure 1

Figure 2