

The Internet of Everything in focus of connecting patients and doctors to create reliable integrated medical treatment for the best clinical outcome – Nature4U medical app

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Abstract—The IoE is feasible thanks to IPv6 that can support emerging Internet-enabled devices. In healthcare, IoE enables patients to (pro)actively participate in care, while doctors can focus on emergencies, thus resulting in higher recovery and survival rates. Traditional medicaments are being investigated for positive and negative impact on health, but are also being misused, thus resulting in fatal outcomes. To avoid this, the author of this research has developed a medical app for integrated medicine in Visual Studio and SQL Server. The app provides reliable, complete information about traditional treatments: benefits, risks, side effects and proper dosages. It will eliminate malpractice, prevent inadequate implementation via consultations and empower patient-doctor collaboration, which is especially important if a patient is on a conventional therapy.

Keywords—*Internet of Everything; integrated medicine; medical apps;*

I. INTRODUCTION

A. *The Internet of Everything in Conventional and Traditional Medicine and Reliability of Medical Data Available via the Internet*

“The Internet of Everything (IoE) brings together people, processes, data and things to make network connections more relevant and valuable than ever before - turning information into actions that create new capabilities, richer experiences and unprecedented economic opportunity for businesses, individuals and countries [1].”

This concept is feasible thanks to the next generation of Internet Protocol or IPv6, which can support all the emerging Internet-enabled devices [2].

“The integration of everything is motivated by the market wish to have all processes remotely accessible through a uniform medium – while at the same time understanding that reengineering an infrastructure to allow this for each application independently would be prohibitively costly and time consuming [2]”.

“Moreover, the current evolution from uniform mass markets, to personalized ones, where customization and user-specified adaptation is a requirement, makes the sort of uniform infrastructure found in the Internet, imperative. This allows many components to be re-used, and services to be shared, with correspondingly huge economies of scale and shortened implementation times [2].”

On one hand, implementing the Internet of Everything in healthcare will empower patients to (pro)actively participate in their care, using patient-friendly medical devices and apps from the comfort of their own homes and avoiding unnecessary visits to a doctor’s office. On the other hand, doctors will be able to focus on emergency cases and attend non-critical patients afterwards, thus resulting in higher recovery and survival rates.

E.g. diagnosing Parkinson’s disease is based on patient-doctor consultation and family’s medical history; there is no test, nor cure for this disease [8]. This type of examination can be performed via teleconsultation and is not urgent. However, a stroke patient is, because diagnosis and therapy must be administered within the 3-hour-window [9]. This directly influences the survival and the recovery rate of a stroke patient.

Some doctors prefer and practice only conventional, while others are, apart from conventional, accepting potentials of traditional medicine and are exploring what it has to offer to their patients.

Despite the modern technology and medicaments that conventional medicine has to offer in diagnosing and curing diseases, there are diseases for which conventional medicine, so far, does not have a cure.

Traditional medicine is gaining importance in treatment of various diseases. Therefore, some patients are exploring benefits of traditional (alternative) medicine and are interested in incorporating those treatments in conventional ones, or sometimes even avoid conventional treatments. Both of these decisions can be harmful or even fatal, because patients and

people, who want to lead a healthy lifestyle (who have proactive approach in managing their health), are faced with a significant problem - reliability of data regarding traditional remedies available on the Internet.

Some remedies can bring benefits; others can have negative impact on health. E.g. green tea is rich with antioxidants, but pregnant women are advised not to consume it, because it has caffeine, which, in higher amounts, is correlated with smaller weight of newly born babies [6], [7]. This emphasizes a serious problem - in some situations something can be healthy, but in others can lead to serious health problems and people will not be aware of it.

Another problem is that the name “traditional medicine” is sometimes being misused, thus resulting in human fatalities. Traditional medicine is being underestimated because of these situations, although it should not be. It has a lot of potential.

Traditional remedies are being tested and if confirmed safe, are in focus of providing quality care to people world-wide [3], and combined with medical technology (e.g. CT, MRI, ultrasound) and knowledge which conventional medicine has to offer represent a powerful source in fighting diseases and keeping the world’s population healthy.

This combination of scientific achievements in conventional and traditional medicine is known as integrated medicine and it will be the future of medical science, because their adequate implementation is complementary and will result in better clinical outcomes.

B. Research focus

Therefore, two questions are in focus of this research. The first question is how to help people/patients find reliable, complete information about traditional remedies in one place, which could be used as preventive or necessary treatment or in combination with conventional therapy.

The second question is how to prevent people/patients from simply applying traditional remedies without proper investigation and/or consultation with doctors and eliminate worsening health conditions or even fatal outcomes.

C. Research objective

Based on the previous questions, the objective of this research is to develop a medical app which will enable combined implementation of latest achievements in conventional and traditional medicine in order to get the best treatment results, as well as to eliminate the possibility of having incorrect or manipulated information regarding proper administration of traditional therapy, which can have devastating effects on health.

II. NATURE4U SOLUTION

To give reliable information regarding traditional remedies and enable contact with medical professional, the author of this research has developed Nature4U solution.

A. Who can use this med app?

The solution Nature4U is intended for medical personnel and med students, as well as patients and people who want useful information about adequate administration of traditional

therapy e.g. benefits, potential risks, side effects and proper dosages.

This solution also gives its users an opportunity to consult with a doctor. This option is very important if a user feels that she/he needs additional clarification and especially in cases when a patient is already receiving a conventional treatment.

B. Development tools

The author of this research developed Nature4U as a two part solution with the goal of bringing reliable traditional treatment to users. Visual Studio was used for developing the Nature4u medical app and Nature4u medical website. Nature4u database was created in SQL Server.

For the purpose of demonstration in this paper, information regarding traditional treatment with onion was obtained from [4] and [5].

C. Nature4U Medical app

The first part of the solution is Nature4U medical app (Fig.1). Nature4u medical app has several functionalities.

The first functionality is *Connect to Nature4U*, which automatically directs a user to the Nature4U medical website via Internet connection.

The second functionality is *Conventional therapy*. It has a list of therapies prescribed by a doctor. This type of therapy is prescribed either after teleconsultation between a patient and a doctor, or after physical examination, medical history, test(s) and other diagnostic methods in a hospital.

Conventional therapy is created only by a doctor and then sent to a patient’s device in which case Internet connection is necessary. Every therapy has name of a cure, dosages, timers, check option and a reminder, which can be activated or not.

The third functionality is *Traditional therapy*. It has a list of therapies which can be either “user-prescribed” or prescribed by a doctor, with the same information that is displayed for conventional therapy.

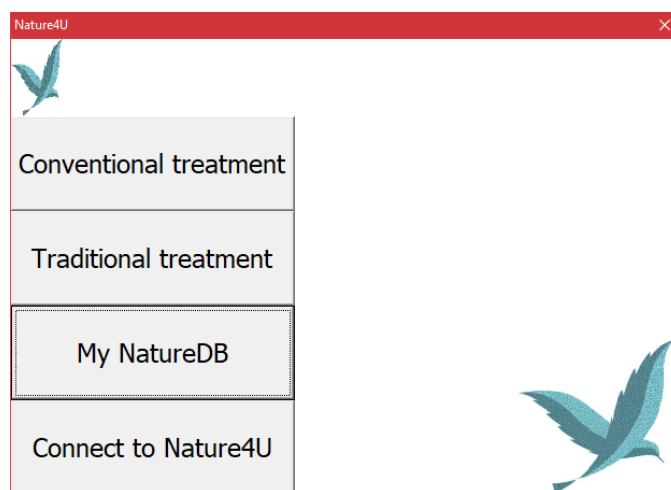


Figure 1. Nature4U medical app

The author advises consulting with a medical professional when creating a traditional treatment, especially if a user is already taking a prescribed therapy.

The fourth functionality is *My NatureDB* (Fig. 2). This is a user-created database, which has stored information about traditional therapy on the user device.

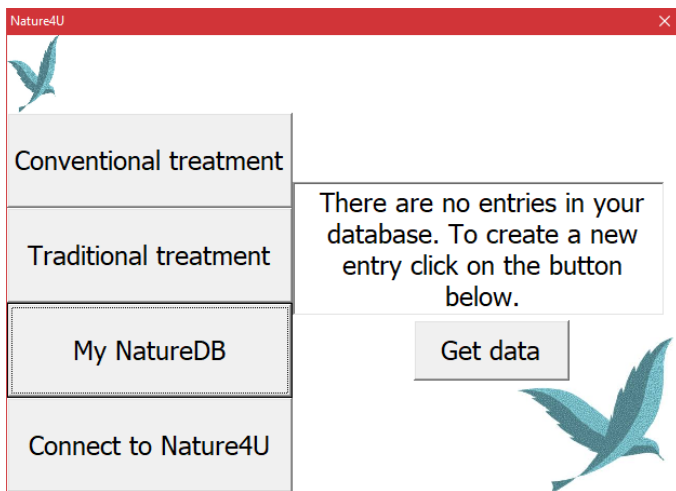


Figure 2. Nature4U medical app – My NatureDB functionality

Information can be added or deleted, and if changes occur in the external DB, when a user connects to Internet, notification is received and user can update her/his DB.

This solution has two major advantages. The first one is that a user is able to create personalized database, which means that the app does not take a lot of space on a user’s device. The second is that updates occur only for does entries that are in a user DB.

Nature4U DB will grow with every new discovery, which means that if complete database would be downloaded, it would eventually take a significant amount of disk space and updates would take a lot of time.

D. Nature4U medical website

Nature4u is a dynamic medical website designed to provide its users with the latest discoveries in the area of traditional medicine.

It is connected with a database, which is updated regularly (when new discoveries are made). Users can access the website free of charge via PC, tablet or a smartphone (Fig. 3, arrows 1 and 2).

They can search the database by a medical disease e.g. cancer, by a problem e.g. how to get a rose torn out or by a medication e.g. onion or sage or they can simply explore the Nature4U database by clicking on the Search button.

The criterion is then sent to the database (Fig. 3, arrow 3) and data is sent to the website (Fig. 3, arrow 4). When information is displayed, user can save the information on her/his device, download the app, begin another search or consult a doctor (Fig. 3, arrow 5).

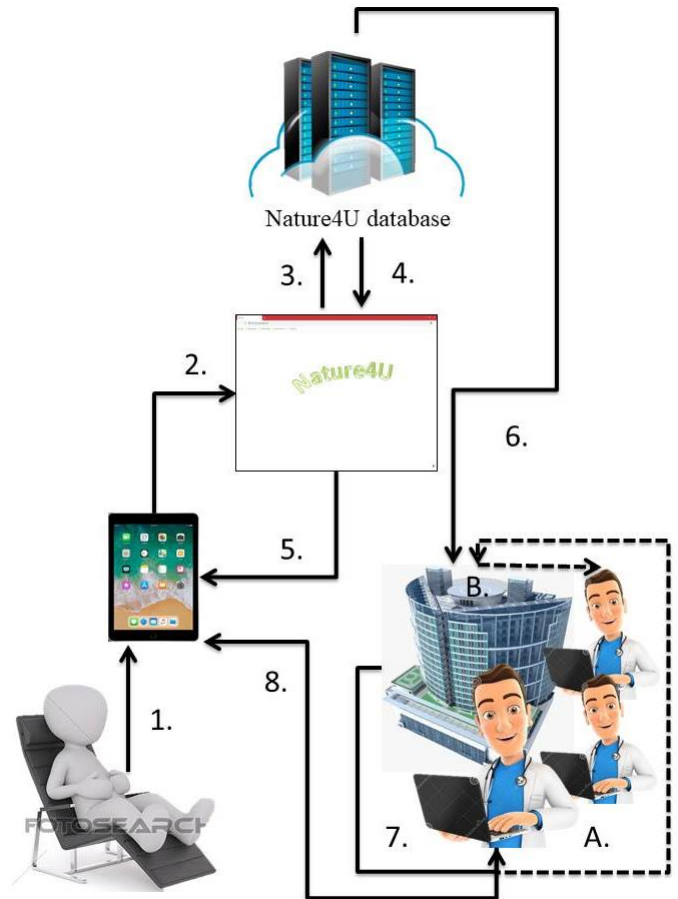


Figure 3. Nature4U solution when only one hospital is included

If consultation is chosen, the user chooses her/his doctor, asks question(s), leaves her/his e-mail address and the content that has been showed on the web page is also sent to a hospital.

The question is received by a hospital server (Fig. 3, arrow 6), which then sends consultation request to a specified physician e.g. a cardiologist (Fig. 3, arrow 7). The physician then replies as soon as possible, but within the next 24 hours max (Fig. 3, arrow 8).

If a physician has a surgery or cannot respond in time and quality, she/he declines and the consultation request is sent to another physician, who is available for consultation (Fig. 3, arrows A and B).

E. The Nature4U network of hospitals

If more hospitals are included (Fig. 4), traditional treatments would still be in one, centralized Nature4u DB, meaning that only one database needs to be updated.

Prescribed conventional therapies would be stored in hospitals’ databases in patients’ e-charts. However, if a user/patient would have questions regarding traditional or

even conventional therapy, those questions would be sent to the hospital where their e-charts are stored, therefore, a user should choose her/his hospital and a doctor within that hospital.

A hospital's system checks the schedule of that doctor. If she/he is available for consultation, that user/patient will receive a reply within the next 24 hours (Fig. 4, arrows 6, 7 and 8).

However, it is possible that the specialist from that hospital would not be able to attend this patient, so the system searches for available doctor inside the hospital (Fig. 4, arrow 7A).

If another doctor is available, she/he will advise the patient within the next 24 hours (Fig. 4, arrows 7B and 7C). If not, the system searches for available doctor in other hospitals in the same county, in the same region and eventually in a state (Fig. 4, arrow 7D).

This means that assumption of electronic health records availability must exist, that is healthcare information systems of hospitals are interconnected.

This is important, because one hospital needs to access resources of other hospital(s), such as list of employed doctors and their medicine branch, as well as their schedule and whether they are trained to practice integrated medicine or not.

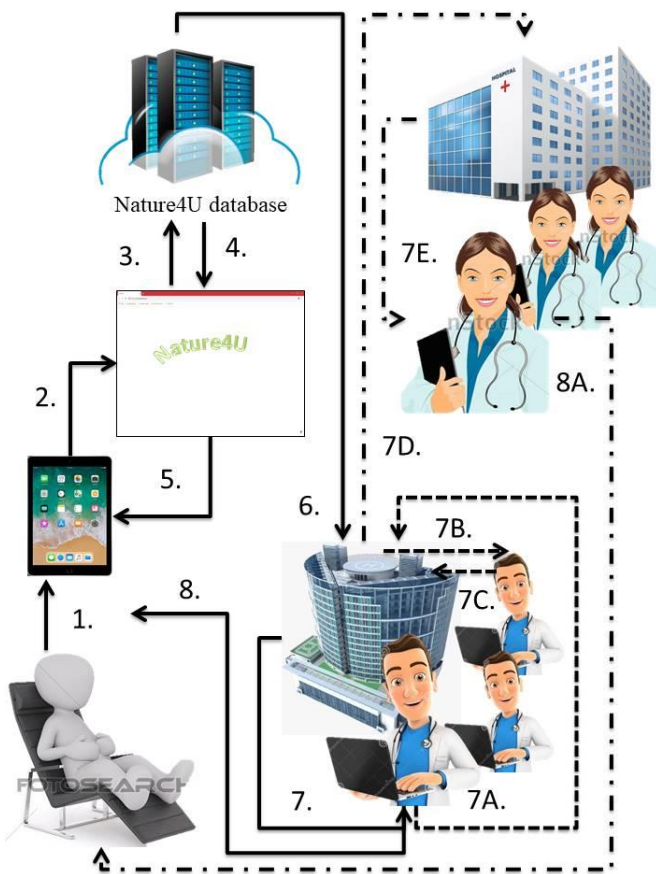


Figure 4. Nature4U solution when two or more hospitals are included

On the other hand, doctor who receives the consultation request (Fig. 4, arrow 7E), needs to have access to that patient's e-chart, which is located in the patients' hospital to give proper recommendation (Fig. 4, arrow 8A).

Therefore, hospitals have to work together to provide the best possible outcome for their patients and they have to face the fact that the future will bring their integration into one unified healthcare center.

III. DISCUSSION

A. Integrative approach in medical treatment via IoE and Nature4U Solution

The Internet of Everything is offering patients and doctors a chance to actively collaborate on managing patient care with devices and apps that are patient-friendly.

Although conventional medicine has advanced in many fields, it is still not able to provide medicaments for many diseases. Therefore, doctors and patients, especially, are exploring potentials of traditional medicine, which is gaining more importance in disease treatment and healthy lifestyle.

However, Internet users/patients are faced with a serious dilemma regarding reliability of information available. To make matters worse, while one treatment can help in one situation, it can create serious health problems in other.

The author of this research presents a two-part solution, with the main goal of applying integrated medical therapy. This solution gives its users insight into traditional therapy - its benefits, potential risks, side effects and proper dosages. It also enables "prescribing" conventional therapy and creating reminders and checking therapy regime fulfillment.

This solution also aims to connect users and doctors so that clarifications could be obtained from real experts and especially if a user/patient is already taking conventional therapy. By doing so, users/patients will avoid unpleasant or even dangerous situations.

B. Implications of Introducing Onion as a Traditional Remedy with and without Information Provided by Nature4U Solution

Why proper administration of traditional therapy is important and how can the developed Nature4U solution prove it can help in supporting conventional medicine?

The Nature4U web site will offer a lot of significant information about pharmacological properties of onion. The patient can decide to download data regarding onion in .pdf without having to install the medical app.

If a patient wants to download the medical app, she/he can do it for free and everything of that patient's interests can be saved in My NatureDB.

Onion as a remedy is a perfect example that a user has to know what she/he is doing and why including a medical professional in this process, either via medical app, website or teleconsultation is of at-most-importance.

This food is known as a blood thinner, which means that it prevents blood from clotting properly. This becomes a

problem if a patient is already using blood thinners or if he has hemophilia.

The following scenarios will demonstrate how integration of onion as a traditional remedy into conventional therapy can help in recovery as well as endanger a patient's health if knowledge is incomplete.

E.g. the first patient wants to integrate onion in her/his conventional therapy. The patient can go to the Nature4U website and search for onion to determine if something like that is possible. This patient had to undergo a valve replacement surgery and now she/he has a mechanical valve and has to drink anticoagulants for the rest of her/his life.

Before introducing onion in diet, this patient should have more information regarding onion and heart diseases. Onion is healthy, because it regulates blood pressure, decreases LDL (negative cholesterol) [4], helps in fighting cancer, obesity, diabetes type 2, hypertension, cataract and disturbances of the gastrointestinal tract [5]. Therefore, this patient could think that introducing onion into her/his diet will be a positive change.

This patient's decision would be wrong and it could have resulted in serious health problems. But, when making decision regarding onion introduction, this patient had additional information from Nature4U DB, where is clearly stated that people who are drinking anticoagulants mustn't consume onion, because of inhibition of platelet aggregation [4], [5].

The second patient has received notification from her/his doctor that a surgical procedure is scheduled in 10 days, so this patient can read that 7 days before surgery she/he mustn't consume onion for the same reason previously stated [4], [5].

The third patient is fighting against bad cold or an infection and onion is considered as a good treatment against these health problems [4], [5]. But only if this patient does not have hemophilia.

If patients did not have these additional information, they could have endangered their health, thinking that what they were doing was useful for their recovery or health.

Also, if a patient has any dilemmas regarding safety, she/he can contact a doctor via the Internet (through Nature4U website or Nature4U medical app) to determine if there are any obstacles in using onion as traditional therapy or preventive care.

The author of this research strongly recommends consulting a doctor before applying traditional therapy, especially if already on conventional treatment, because insufficient information can endanger a patient's health.

IV. CONCLUSION AND FUTURE WORK

The Internet of Everything will enable users/patients to actively participate in their care by using user-friendly medical devices and apps and integrating conventional and traditional medicine.

The author of this research developed the Nature4U medical solution, with the main purpose of providing its users reliable, complete information about traditional remedies, as well as to enable contacting medical personnel regarding implementation of traditional therapy solely or in combination with conventional one, thus eliminating negative influence on patients' health.

In the future, the author will further develop Nature4U DB, by enriching it with more useful information regarding traditional therapy, based on books, clinical trials, scientific papers and consultations with doctors who are implementing the concept of integrated medicine.

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