Intelligent Internet: natural language and question & answer based interaction

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Abstract – We propose to convert today's Internet into an Intelligent Internet that can be easily used by all people – literate, semi-literate and illiterate – in much more useful, effective and valuable ways. E.g. if we type ***"****how many students graduated from Stanford University in Computer Science in 2012****?"*** in any search engine today, the results will be things like "Stanford university Palo Alto; Stanford university campus; computer science at Stanford etc etc". The real answer will not be there as the question was not understood to begin with let alone figuring out the answer.

In order to get the correct answer, we need two broad parts from technical standpoint: one is natural language based interface that clearly understands user's requests, and the other one is an engine that can take necessary actions & provide the most appropriate answer. Speaking boldly, we are talking about a robust Question & Answer (Q & A) system with a very large domain. Handling of such a large domain is possible through a **Semantic Engine**.

We have applied the Intelligent Internet (IINT) concept for farmers as the need to provide the benefits of the Information Age to farmers, the major segment of the Base of the Pyramid people (BOP), is very important from various aspects including their survivability, Economic, Social, Cultural and other developments, and minimizing the Digital Divide & Rich-Poor gap. Since many farmers are illiterate, live in rural areas where Internet Access is limited, and cannot easily afford high end mobile devices, existing methods have severe limitations in providing the benefits of the Information Age to such population. We describe a practical affordable solution using IINT applied to a Farming Mega Portal (FMP) that can be accessed from any phone using user's voice and natural language. Our approach includes information access, interaction, e-Learning, transaction and social network aspect so that farmers can effectively use FMP to improve & increase food production and minimize food waste. We emphasize on Innovation and Entrepreneurship for farmers to ensure immediate and sustainable significant impact on Economic, Social and Cultural & other developments, along with creation of an enormous "Resource ".

The IINT will take the Internet to a new level and will allow existing as well as significant number of new users to enjoy the existing and various new benefits of the Internet, and affect their lives in a positive way with Economic, Social, Cultural and other developments globally.

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I. INTRODUCTION

It is important that everyone can access and enjoy all major benefits of the Internet easily and economically. It is needless to mention the importance of the Internet for education, employment, economic, social, cultural and other developments, and more. As Internet is becoming an important and essential part of everybody's (who have access to it) life, the need for accessing the Internet are becoming even more important for the people who have no access to it. For example, most farmers do not have access to the Internet.
As we know farming is very important not just for farmers but for all as one of the basic necessity for survival is food; and it is applicable for all human being. Accordingly, farming and hence e-Farming are important for all. Thus, it is very important that farmers can access the Internet and use all the benefits of the Internet in farming via e-Farming. For example, e-Farming can be effectively used by farmers to improve and increase food production; to minimize food waste; to sell food directly to the buyers, bypassing middlemen; thus significantly improving overall return to the farmers, which in turn provides great incentive to farmers to produce more food. Similarly, e-Health can provide very valuable information to many people at the Base of the Pyramid (BOP). For example, how to avoid getting infected from HIV, how to control or prevent diabetes and the like. Similarly, with access to e-Gov, many BOP can easily communicate with their Govt. and get critical information about employment, apply for jobs, access / apply for various records (e.g. Birth Certificate), pay bills and more.

It is important to note that elderly, blind / visually impaired & highly mobile people, and people with other disabilities have similar problems in accessing & using the Internet.

Thus, everyone **should have the access to the Internet** so that they can enjoy all the key benefits of the Information Age. Unfortunately, only a small fraction of population (about 14% globally [1]) can access the Internet today resulting a very **large Digital Divide**.

In [1] & [3] we argued that **existing approaches to bridge the Digital Divide are good but not sufficient to completely bridge the Digital Divide**. We then showed a more practical solution using "**Voice Internet**" to provide the benefits of the Internet to over 5 billion people (out of about 7 billion people in the world) who have some access to a phone. In Voice Internet, users just make a phone call using any phone and interact with IA by talking and listening. Users can surf, search, do email and complete transactions by voice. The phone acts like a computer & audio browser. It is like an IVR (interactive Voice Response system) but web based i.e. sort of putting the whole Internet on an IA based IVR [more on Voice Internet in Section 4.2].

Effectively bridging the Digital and associate Language Divides [2], [5] is the first important step. However, it is not enough as we need to make sure that Internet is usable by all population including BOP, especially in their economic and social developments.

Today's Internet is mainly usable by the literate people. Semiliterate and illiterate people, who dominate the BOP, have great difficulty in using it in various ways:

a. Fearfulness in using a computer or similar complex devices.
b. Difficult User Interface.
c. Literacy issue – not able to read or write.
d. Lack of understanding / difficulty in comprehending how Internet can help them in many ways.
e. Difficulty in building confidence that it can really help even if some of them can see the benefits.

Since BOP dominates world population, it is key that we just do not look at bridging the Digital and Language Divides in a general sense. Rather, we need to make sure that such population can really use the Internet and get all the benefits of the Information Age, especially, for their economic, social, and other developments including increased global peace.

Thus, in devising a solution for such population, we would need to effectively address all above mentioned difficulties they have. The Intelligent Internet (IINT) addresses all these issues well as

A) anyone can talk & listen (even though may not know how to read or write),
B) anyone can see and enjoy a video or a picture (except if blind),
C) a natural language based interface makes it very comfortable,
D) a Question & Answer (Q&A) type approach (along with associated rendering [1], [2]) makes it easy to interact, easily get desired information & easily learn a specific topic,
E) a mechanism to make all necessary transactions with simple sentences,
F) a mechanism to communicate with others naturally
G) and more

Moreover, all these are also good for all including literate people. E.g. anyone would be very happy to get most desired information (or specific answer) instead of many search results when uses Internet search. Similarly, anyone would be happier to ask a question rather than put some search words in various combinations to get better search results.

In the context of farming, we would need to provide farming related key information, associated e-Learning, e-Mail, various transaction capabilities including on-line marketing & selling opportunities, social network based community learning as well as some hands-on training. Hands-on training with practical examples is important as not many farmers would immediately understand the available information and see the connection how to use such information/knowledge in their day to day life. Besides, they would need some hands on training to quickly learn how to access and interact with the Internet. To make the process easier & attractive, we need to ensure that they can easily learn, use and get attracted to the needed information. This, in turn, will minimize the needs of hands-on training. All these Internet related features are provided via our Farming Mega Portal (FMP). Voice Internet supports FMP.

In this paper, we describe IINT and its implementation for farmers, FMP along with some practical hands-on examples. FMP is important as farmers would need to get all the needed information from one place in a natural way using natural language. Traditional Internet portals will not serve this purpose as such portals are designed mainly for literate people. Accordingly, we introduce an Intelligent Agent (IA) based FMP so that the complexity of using traditional portal is handled by the IA, thus letting farmers to use a very simple, effective and easy to use information system. Our proposed FMP using Voice Internet technology, effectively addresses above mentioned key issues related to BOP.

Section II describes the basics of the Intelligent Internet (IINT), the core concept to our approach. Section III describes the key parts of the Semantic Engine (used in IINT) using Brain-Like approach. Section IV describes what farmers would need as they would not be able to effectively use traditional portals, transaction sites or the Internet. Section V describes Farming Mega Portal (FMP). Section VI describes some applications in farming.

Section VII describes how FMP concept can be used for other applications, and Section VIII shows how it can be extended to make IINT. Section IX describes the benefits of our approach for various population groups, and Section X provides Conclusion.

Intelligent Internet will take Internet to a new level and will allow existing users as well as significant number of new users

to enjoy the benefits of the Internet and affect their lives in a positive way with Economic, Social, Cultural and other developments globally.

II. THE INTELLIGENT INTERNET (IINT)

The idea of having a Q&A type system is as old as the dawn of the computer age. This dream has not been realized yet mainly because of the absence of the needed technologies.
E.g. if we type the question

"**how many students graduated from Stanford University in Computer Science in 2012**?"

in any search engine today, the results will be things like "Stanford university Palo Alto; Stanford university campus; computer science at Stanford etc etc". The real answer will not be there. The following are the key reasons for not getting an appropriate answer:

1. the question was not understood to begin with mainly because of the lack of semantics of the words and the sentence
2. it is not easy to perform the task of going to the Stanford University database, getting authorized access, finding and retrieving the requested data
3. not knowing how to compose a nice answer.

Existing approaches to define and process semantics have good applications mainly in a small domain. The key reason is "artificial" or "mechanical" semantics that does not scale and fails with relatively small change in the words or sentence as discussed in more details in Section III. The 2nd problem is related to the difficulty in implementing the task. There are multiple issues including authorized access to the database, rendering & filling appropriate forms, understanding data fields in a database, relating, identifying and retrieving the appropriate data fields. It also includes other issues like with deep search. The 3rd problem i.e. composing a nice answer needs very good knowledge of human natural language including semantics. In fact, semantics is also a key issue for the 2nd problem i.e. understanding, relating and retrieving appropriate data fields in a database.

A relatively simpler problem applies for questions that do not necessarily need a database access. For example, in the question

"can you find low-price Thai restaurants in Silicon Valley?"

a database access is not really needed as an answer can be derived by searching all Thai restaurants, rendering appropriate content and comparing their prices (assuming that prices are available on their websites etc). Hence, use of appropriate semantics is the key to answer such questions.

The term "rendering" ([1], [3], [5]) needs some attention. As we know, the Internet was designed with visual access in a relatively large display screen (like a 8.5 inch x 11 inch page) in mind. Thus, all the content are laid out on any website and webpage in a manner that attract our eyes in a large screen. Retrieving the desired content (which is much smaller in size than the total content on a webpage or website) from a typical webpage / website and displaying that into a much smaller screen (like in a cell phone or PDA) is a challenging task. This process of retrieving and converting most desired content from a large source of content into a much smaller display is called **"rendering".** It is important to note that such rendered content are also good to play in audio as the content is short and most desired. The rendering process significantly eases the navigation, especially within a page as rendering includes finding the most desired content in an automated way. Because the most desired content can also be searched from multiple web pages, rendering also to some extent helps navigation between pages. Clearly, finding most desired content is very difficult as just string matching does not produce most desired content in a reliable way. Accordingly, more than string matching, including Natural Language Understanding (NLU), Natural Language Processing (NLP), and Artificial Intelligence algorithms are needed; thus making the process very complex. Semantics also helps the rendering process. The concept of rendering also applies for forms on a page.

In addition to rendering appropriate content & form, we also need to render streaming audio and video content as such content are increasing rapidly on the Internet.

Clearly, the key problems can be grouped into two broad parts from technical standpoint:

a) a natural language based interface that clearly understands user's requests,
b) an engine that can take necessary actions & provide the most appropriate answer.

A good **Semantic Engine** is the key for both (a) and (b). However, an Intelligent Agent (IA) is also very important to handle all tasks in (b). IA also plays a good role in (a). In the remaining part of this Section, we address the key tasks of the IA, and Semantic Engine is discussed in Section III.

The architecture of IA is shown in Fig. 1. Each website would need to have one or more IAs. There can also be Super Intelligent Agent (SIA) to do more complex higher level tasks and collaborating with the lower level IAs on each websites. Today's websites do not have any IAs although some websites do have some of the functions of IA – e.g. using web services. The environment of an IA is basically the HTML/XML content of the site, content of other sites if those sites do not have any IA, IAs of other sites, SIAs and the users. Thus IINT is a system of IAs and

SIAs, usually, working in co-operation (unless we are talking about two competitive sites). It is important to note that each website would need to have an IA to be much more effective – *a major paradigm shift in website design and implementation*.

2.1 ***Algorithms for IAs and SIAs***

Agents for IINT need to have some special properties in addition to what conventional IAs have. IAs on IINT can be of the following major types and their combinations:

1. Delivering requested content
2. Calculating some functions – e.g. currency conversion
3. Performing transactions – e.g. an e-Commerce application
4. Performing teaching and learning – e.g. an e-Learning application
5. Performing networking type activities
6. Intelligent information retrieval or intelligent search
7. General Q&A, Summarization and Drawing Inference
8. Complex content manipulation

NLU (Natural Language Understanding; with a Semantic Engine as a core component) based User Interface (UI) and Q&A type behavior are the keys for all these agents. Thus, IA and SIAs on IINT will include almost all algorithms used by various existing agents PLUS special emphasis on the NLU based UI and Q&A System. IAs and SIAs will also have learning & generalization capabilities along with capabilities to handle uncertainties well.

It is important to note that IA and SIA will work fine with Semantic web constructs that are used to help define semantics. However, defining semantics this way for all website is very difficult as it is not scalable. Re-writing of websites using special tags / constructs is needed with this approach of adding / defining semantics.

On the other hand deriving the semantics automatically from the existing web content (see Section III for more) nicely avoids re-writing (and hence avoids scalability issue except that an IA needs to be added but without any change to the content; and IA can reside anywhere including on the cloud) of web-sites.

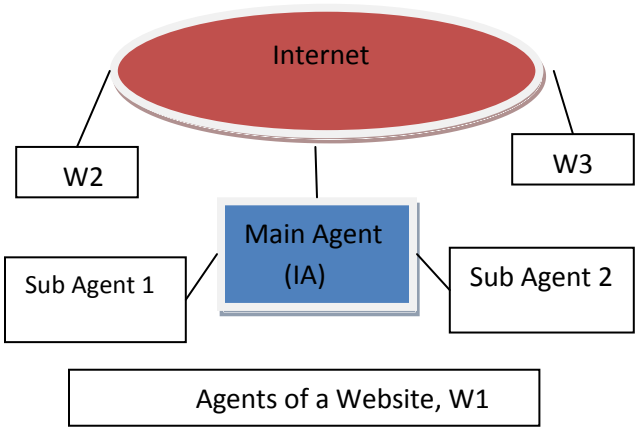

Figure 1: Intelligent Internet (IINT) - showing a website with a main Intelligent Agent (IA) and 2 sub Agents. Sub Agents can perform functions like transactions or e-Learning etc. Such a website can have a Super Intelligent Agent (SIA) to handle more difficult tasks by collaborating with other websites. The Agents may reside on a different website(s).

III. SEMANTIC ENGINE

While traditional approaches to Natural Language Understanding (NLU) have been applied over the past 50 years and had some good successes mainly in a small domain, results show insignificant advancement, in general, and NLU remains a complex open problem. NLU complexity is mainly related to **semantics**: abstraction, representation, real meaning, and computational complexity. We argue that while existing approaches are great in solving some specific problems, they do not seem to address key Natural Language problems in a practical and natural way. In [16], we proposed a Semantic Engine using **Brain-Like approach (SEBLA)** that uses Brain-Like algorithms to solve the key NLU problem (i.e. the semantic problem) as well as its sub-problems.

An IA uses SEBLA in the following ways:

1. Understands user's request and break it into key component parts.
2. acts on all the component parts, find requested answers by accessing appropriate sources (including database tables).
3. assembles a concise answer, and then present it in a nice way.

The IA itself also uses SEBLA's natural semantic engine to make correct decisions by avoiding "mechanical semantics", as commonly used in existing systems.

The main theme of our approach in SEBLA is to use each word as object with all important features, most importantly the semantics. In our human natural language based communication, we understand the meaning of every word even when it is standalone i.e. without any context. Sometimes a word may have multiple meanings which get resolved with the context in a sentence. The next main theme is to use the semantics of each word to develop the meaning of a sentence as we do in our natural language understanding as human. Similarly, the semantics of sentences are used to derive the semantics or meaning a paragraph. The 3rd main theme is to use natural semantics as opposed to existing "mechanical semantics" of Predicate logic or Ontology or the like.

A SEBLA based NLU system is able to:

1. Paraphrase an input text.
2. Translate the text into another language.
3. Answer questions about the contents of the text.
4. Draw inferences from the text.

As an example, consider the following sentence:

"Maharani serves vegetarian food."

Semantics represented by existing methods, e.g. Predicate Logic, is

Serves(Maharani, Vegetarian Food) and
Restaurant(Maharani)

Now, if we ask
"is vegetarian dishes served at Maharani?"

the system will not be able to answer correctly unless we also define a semantics for "Vegetarian Dish" or define that "food" is same as "dish" etc. This means, almost everything would need to be clearly defined (which is what is best described by "mechanical semantics"). *But **with SEBLA based NLU, the answer for the above question will be "Yes" without adding any special semantics for "Vegetarian Dish".*** The "mechanical semantics" nature becomes more prominent when we use **more complex predicates** e.g. when we use **universal and existential** quantifies, and/or add constructs to represent time.

It is important to note that ML (Maximum Likelihood) based performance commonly used in prediction (e.g. when one types words in a search field on a search engine it shows the next word(s) automatically) will be improved with natural semantics. Currently, mainly ML (and sometimes other techniques including existing semantics methods) is used for prediction. By using proposed more natural semantics (e.g. using SEBLA), the meaning of the typed words will be more clear; thus helping better prediction of the next word(s). It will also help using natural sentences in the search field than special word combinations, e.g. when using advanced search.

IV. WHAT FARMERS NEED

Farmers are major part of the BOP. In [1], [2], [4] & [5] we emphasized that for the **BOP**, we would need to provide access using an ubiquitous device (like a simple phone), with a natural user interface (like Voice), without a requirement to be literate (no need to know how to read or write; rather use talking and listening), use existing content on the Internet (avoiding to re-write web pages with another language like WML), and start with simple most desired services (like e-services).

As already mentioned, after effectively bridging the Digital and Language Divides, we would need to utilize the access to the information to knowledge, use knowledge to drive innovation & entrepreneurship to finally drive economic, social, cultural and other developments with increased world peace. In the context of farming, we would need to provide farming related key information, and all associated features (e.g. e-Learning, e-Mail, transaction capabilities,..) via Farming Mega Portal (FMP).

Our proposed FMP using Voice Internet technology, effectively addresses all key issues related to technology adoption, lack of extension services and affordability as

(a) it provides a very simple and attractive natural user interface using user's voice and any phone.
(b) it allows users to just talk and listen, avoiding the need for literacy.
(c) It requires just a basic phone which is affordable and owned by many BOP.

These, in fact, significantly reduce the **fearfulness of using technologies** (which is the key hindrance in adopting new ICT based applications), especially for farmers (and BOP in general). Voice Internet technology has been used by many users in US & Canada over 5 years and in some developing & underdeveloped countries for over one year. Its adoption and use have been very positive.

Our approach includes both informal and formal learning (including learning how to read or write using natural language). We emphasize on practical informal learning on

Innovation and Entrepreneurship to ensure immediate and sustainable significant impact on Economic, Social and Cultural developments along with a valuable "Resource Creation", and thus show a better causal relationship between education and eradication of poverty.

4.1 Paradigm Shifts

Apart from technology standpoint (e.g. FMP & its usage to help farmers as mentioned above), we also would need some major paradigm shifts.

Many underdeveloped and developing countries are rich in resources, dominated by arable land (in general, over 70% populations are farmers. Agriculture is the main source of income and food security). For example, in Africa, Nigeria, Zambia, and Uganda are very rich in resources. Less than 50% of Nigerian arable land can feed the whole Africa if agriculture potential is exploited well. Nigeria used to export food before oil exploration that started in 1970. Now it imports food. Thus, Nigeria can lead itself to prosperity by making its economy agrarian again by doing a major "**transformation in agriculture**", especially using ICT, biotechnology & associated nanotechnology, and properly addressing all agriculture related issues. The same is true for other countries in Africa, Asia and South America.

All we need is some Major Paradigm Shifts, Plan and Execution so that we can fully exploit all the resources and ensure Economic, Social, Cultural & other developments (including increased peace) and prosperity. *The paradigm shifts mentioned below use Africa as an example. But these can be applied to other regions.*

a. ***The 1st paradigm*** *shift is the fact that Africans can be "producers" & not remain as "consumers".*
b. ***The 2nd paradigm*** *shift is to effectively bridging the Digital and Language Divides by using Voice Internet.*
c. ***The 3rd paradigm*** *shift is that just bridging the Digital and Language Divides is not enough; we need a complete, fully integrated strategy to tie all these along with Education, Innovation and Entrepreneurship.*
d. ***The 4th Paradigm*** *Shift is that agriculturally resourceful countries need to really focus on Agriculture as it can make such countries really prosperous.*

Education is a key component to nicely and effectively tie all above, and develop knowledge from the information. It is also a key component for innovation and entrepreneurship. To stimulate real economic growth, "education" needs to be highly emphasized and targeted, especially with "**creativity", "productivity" and "resource" creation** in mind. Creativity will in turn **drive innovation, entrepreneurship, productivity** and more. And we need to focus on both formal and informal education to ensure that the farmers and **BOP** are active part of this process. Accordingly, an **Educational Reform** is also needed.

To ensure that we can successfully realize the above mentioned paradigm shifts and successfully achieve our goals, we need a very good platform – this proposed platform is the **FMP** (mentioned above) that will enable farmers to become entrepreneurs, become innovators, become educated & knowledgeable, become an enormous resource, and become leaders in making the change. **FMP** would enable farmers to get out of poverty fast and then move toward prosperity. Such a mega portal would also help create a great resource from the educated class (as developing such mega portal involves new approaches, algorithms & techniques), create new jobs, businesses and revenues with sustainability and good growth. In addition through Voice Internet, the FMP can be accessed through Mobile Internet or regular computer based Internet.

4.2 *Effectively Bridging the Digital and Language Divides*

The existing approaches of bridging the Digital Divide can be broadly classified into **three groups**:

(a) by providing computers or low cost simple computers or computer like devices to people who do not have one.

(b) by providing personal devices like PDAs and cell phones with good size display screen.

(d) by using TV with a set-top box.

As already mentioned, In [1] and [3] we have argued that existing approaches to bridge the Digital Divide are important and will minimize the Digital Divide but are not sufficient to truly bridge the Digital Divide, mainly for the following reasons:

1. Connected computers represent about 15% of the total phone population. Besides, for many people (especially at BOP), learning and using a computer is difficult.
2. Personal devices like a cell phone with good size screen or PDA are great devices to communicate via voice or text with small content. But these are not good devices to do computing or to access the Internet. The key reasons are:

a. difficult user interface because of small screen and small keypad. In fact, these devices are getting smaller, in general, whereas our eyes and fingers are not.

b. The content is limited as one would need to re-write the content in another language like WML (Wireless Markup Language) in case of cell phone viewing; or the content needs to be manually scrolled in case of a PDA.

c. Visual access makes such devices difficult in an eyes busy-hands busy situation like while driving.

d. Many people, especially, in the developing world do not know how to read or write. So, a visual display based access would not be very useful to such population.

Accessing the Internet via a TV and set-top box has not been very successful yet. However, it has a great promise. With TV becoming more interactive device, people getting more and more familiar with the Internet and more attractive content becoming available through digital TV and IPTV, Internet access via TV shows great potential. The cost issue and fear of learning how to use a computer will be significantly minimized for many people. However, most of the other key issues mentioned for computer or mobile phone based access will still apply – like digital TV will still be beyond reach by many people at the base of the pyramid, learning how to use complex features will still be there via a complex remote control.

Voice Internet overcomes the difficulties mentioned above with existing approaches:

- no need to buy a special device (thus allowing easy & affordable access to many more people)
- no need to deal with small screen or small key pad as users basically talk and listen
- much easier to learn as learning how to use a phone is much simpler than learning how to use a computer or personal device
- no need to re-write the content in another language. There are over 3 billions of websites on the Internet. Re-writing all of them would be very expensive and hence not practical
-no requirement to know how to read or write

The **other key challenge that Voice Internet overcomes** is the **"rendering"** problem. The Internet was designed with visual access in a large display device in mind. Thus, all the information is laid out in a manner that attracts our eyes but not ears. **Rendering or converting such information into short, precise, easily navigable, meaningful and pleasant to listen to content** is a very hard problem that Voice Internet has overcome. These key features of rendering are very important as when listening, one does not have time to listen to everything on a page, would like to move around easily and quickly and make sure that content heard is the content that was desired.

An **Automated Attendant (Intelligent Agent, IA)** is used to perform the "rendering" function. IA performs rendering by

(a) automatically generating important information of the page, called, "Page Highlights", presenting them in a small amount of information at a time that one can easily follow

(b) finding appropriate as well as only relevant contents on a linked page selected by a Page Highlight, assembling the relevant contents from a linked page, and presenting them, and

(c) providing easy navigation.

Rendering allows users to easily navigate within and between pages using simple voice commands or keypad entries. The Intelligent Agent is capable of learning user preferences, and thus can continually improve ease of access and use over time.

Rendering is achieved by using algorithms similar to the algorithms used by sighted users. The key steps of rendering are done using the information available in the visual web page itself and employing appropriate algorithms to use all such information including text contents, color, font size, links, paragraph, amount of texts and meaning of the words. Some language processing algorithms are also used to further refine the rendering, navigation and filling of on-line forms (Form Filling). This is similar to how the brain of a normal sighted person renders information from a visual page by looking into the font size, boldness, color, content density, link, meaning of titles/labels, and then selecting a topic, going to the desired page and then reading only the relevant information on the desired page. Form filling is done by presenting forms as Form Page Highlights and also creating appropriate questions, taking the text/voice inputs from the user and then filling and submitting the form.

Thus, a user can seamlessly access any content on the Internet, interact with any forms and complete transactions like shopping, banking etc. using a simple phone and his/her own voice. Another key feature is that content can be translated in real time into another language, providing audio access to, for example, English-language web pages for those with limited English language skills, thus bridging the **Language Divide**. A good example of Voice Internet is netECHO® from **InternetSpeech, Inc, a company based in California, USA (www.internetspeech.com).**

V. FARMING MEGA PORTAL (FMP)

Our e-Farming / e-Agriculture solution, FMP is built on the Voice Internet technology as it addresses some of the major issues related to the farmers in providing key farming related information & associated education (via e-Learning). Key major issues addressed by Voice Internet are:

A. Help bridges the Digital and Language Divides in an effective way to ensure easy access to the Internet through a ubiquitous device like a simple phone.
B. Uses voice and natural language for interaction.
C. Renders content into Short, Precise, Easily Navigable and Meaningful content.
D. Users basically talk and listen to the Internet using their voice and hearing.

These key features available in Voice Internet are enhanced with an augmented Intelligent Agent to handle the e-Farming & related e-Learning needs.

Thus, ***FMP*** *i.e. the* ***Voice Internet e-Farming Intelligent Agent (VIEFIA – Fig.2) addresses the following additional issues:***

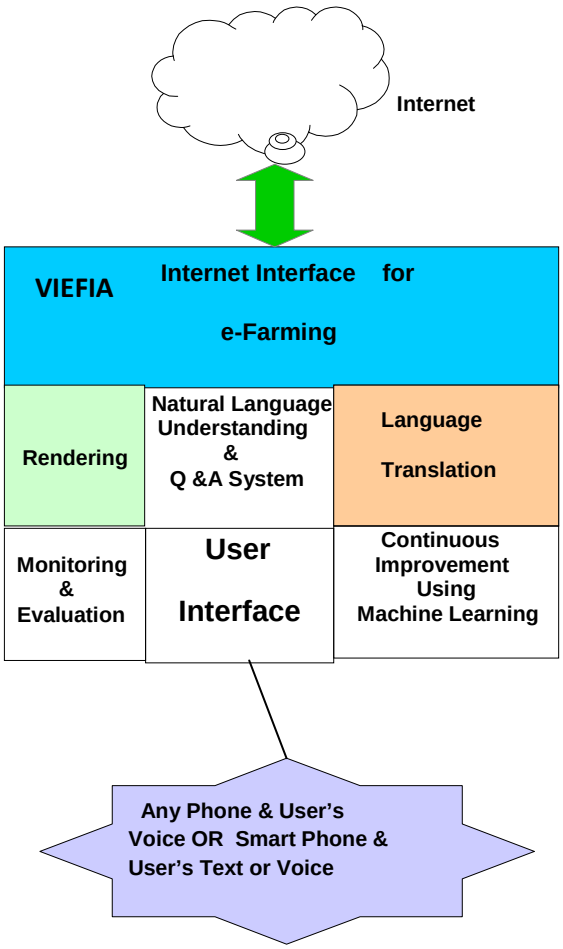

Fig. 2 VIEFIA: Voice Internet e-Farming Intelligent Agent or Farming Mega Portal (FMP)

E. Uses Question and Answer type System Approach in the domain of Interest.

F. Focus on some good "Automated Methods" to ensure that content delivery, use, teaching and learning are simple, natural and easy.

G. Uses special Interface supporting both audio & visual display with emphasis on picture or image based interface as many farmers cannot read or write (***see below for more visual interface needs***). HCI (Human Computer Interaction) issues for illiterate/semiliterate people are highly emphasized in the FMP Webapp.

H. Focuses mainly on "informal education/courses" as farmers would need something affordable, simple and quick that would help them much sooner than going through some formal degrees or certificates.
I. Focuses on Innovation and Entrepreneurship as these are critical to expedite and sustain development.

VIEFIA also supports visual access as farming through mobile devices with visual interface will become attractive as farmers already would have seen the value of Voice Internet based FMP and learned it quickly at ease. Many would learn how to read and write (at least basic stuff) - a necessity for visual interaction, and thus will be open to visual interaction. Visual interaction is also important for pictures, movies, images, tables and the like. Such visual based interaction will also be accompanied by voice based interaction – e.g. inputting information / data can be voice to ease the process. As mentioned, the display of content and their appropriate labeling use image/pictures and voice in addition to text as many farmers are not literate.

These additional features (related to the corresponding additional issues mentioned above – points E-I) are achieved by using better content management, enhanced dialogue design, enhanced rendering, Natural Language Understanding, Q&A approach and an automated way to improve performance over time using some self-learning.

5.1 User Interface (UI)

As mentioned, FMP has both audio and visual interface. IA based Q&A is good for both audio and visual interface. In general, NLU & voice based Q&A is more preferred as typing the question or seeing the answer on a small screen is not easy. Besides, while mobile (driving, walking), visual interaction is very difficult / not possible. Apart from Q&A, NLU & voice / audio based content listening and navigation is also more preferred. However, as mentioned, for some content, visual access is very useful – e.g. looking into a table, picture, and video.

Today's visual portals (like Yahoo) are mainly tuned for literate users. People unfamiliar with the Internet or illiterate people would need something different. For example, the UI must be very simple, intuitive, easy to learn & use, and attract

users who may not know anything about the Internet or portal. Voice and Natural Language Understanding (NLU) is the key for such interface from input standpoint. From display standpoint, text description cannot be the primary mechanism. Thus, to show a link for "Mango", we need to show an image of a mango with a visual flash. If a user says "mango" or "information on Mango", or touch on the image of mango, it should go to the desired page. The desired page should show most of the information in image/video /audio form in addition to the text.

The navigation tree should be very short or desired content need to be found by simple voice command or natural sentence and through the help of IA.

As already mentioned, the IA will work as a Domain Specific Question and Answer system as farmers cannot easily retrieve useful information using existing Search engines (as there will be too many results). In the same way, the IA would need to support NLU based e-Commerce or e-Learning. Thus, a user should be able to says things like

"*Who are the key buyers for tomato paste? Please provide contact information for the top 3 buyers in the region"*

VI. EXAMPLE FARMING APPLICATIONS

We describe two major farming applications that use FMP in a major way:

(a) minimizing food (e.g. tomato, mango) **waste.**
(b) improving & increasing food (e.g. rice, wheat) **production.**

As mentioned, we emphasize on Innovation and Entrepreneurship to ensure immediate and sustainable significant impact on Economic, Social, Cultural and other developments along with a valuable "Resource Creation", and help eradicate poverty. Immediate economic & social impacts are high motivators. The two applications described below show immediate economic & social impacts.

Minimizing food ***(****e.g. tomato, mango****)*** **waste:**
Many food get wasted everyday as farmers do not know how to preserve them or do not know how to sell them directly. E.g. in Zambia, waste of tomato and mango are over 80% on the average. This is a huge loss – money just gets lost in front of the eye's of the farmers whose per day income is usually under $2. With a small investment of $150 (usually through Voice Internet based Microfinance ([1], [11]), hands-on training and using FMP, farmers can convert tomatoes to tomato paste and mangoes to mango paste. They can then also sell the pastes via on-line marketing & selling capabilities of FMP. Their income jumps from less than $2 to $8 - $12 per day. This is a relative high jump in their income and a great motivating factor to get excited, become more entrepreneurial and innovative to apply their knowledge in other similar areas including making various milk products.

The small investment mentioned is needed to buy some basic equipment (e.g. frying pan, food mixer) to convert tomato to tomato paste.

Improving & increasing food (e.g. rice, wheat) **production:**

Increasing and improving rice or wheat production is very important as these are key components of "food security". Such an effort depends on the following key factors:

- improving soil condition
- using better seeds
- using better fertilizers
- using better pesticides
- know appropriate dates for harvesting
- knowing weather conditions on a regular basis
- knowing where from and how to get key materials (seeds. Fertilizers,..)
- improved process of harvesting
- and more

All such key information are in the FMP. Thus, farmers get easy access to such information. Again by using some small investment (especially through Voice Internet based Microfinance) and hands-on coaching, farmers can improve & increase their food production in a significant way.

Such efforts are being undertaken in a few countries including Zambia and Nigeria. It is important to note that "**money always talks**" – thus, when farmers will see that their income is increased, they will become motivated, excited and inspired. These will **easily overcome** most barriers in using any new technology (such barriers of using new technologies are well known in the literature and are the major causes for the Digital & Language Divides). Farmers will become very interested to learn how to use all features of Voice Internet, Farming Mega Portal, take e-Learning classes and will become entrepreneurial and innovative. This is a major theme of our proposed approach and we have seen good initial results in a few countries including Zambia.

VII. APPLYING FMP CONCEPT IN OTHER APPLICATIONS

The FMP concept can easily be applied for various other applications, e.g. e-health, e-Gov, e-Learning. All such applications need to provide all related content, features and services in one place, like Health Mega Portal for e-Health. NLU, Q&A and IA based interface and interaction, especially with voice is key for all BOP. The basic architecture of the IA

will not change from FMP. However, some minor refinement might be needed – e.g. Health Mega Portal (HMP) would include patient records which would need some additional security. But similar security is already there for transaction functions in FMP. So, some minor refinement can easily be made to use the security feature for accessing patient records.

The same is true for Learning Mega Portal (LMP). In this case, however, more emphasis would be needed in course design, presentation, teaching and learning with special emphasis on informal learning as BOPs are illiterate or semiliterate in general.

VIII. FROM FARMING MEGA PORTAL TO INTELLIGENT INTERNET (IINT)

Clearly, all the IAs shown for FMP, HMP or LMP are similar to the IAs and Super IAs shown in IINT. Thus, IINT is basically a large collection of FMP like portals on the web.

One key difference is that the IAs in FMP will usually reside in FMP (it may not reside in FMP though) whereas many IAs and SIAs on the IINT will reside on different sites – e.g. an Intelligent Search Engine might have multiple IAs and SIAs but they will reside on different website(s) than on all other websites on the Internet as these IAs/SIAs will crawl the whole Internet etc.

Another key difference is the functionality. Some SIAs may have more complex and different functionalities - e.g. an Intelligent more general Q&A system will have additional capabilities to handle better deep-search, more capable content processing (e.g. composing summary of an article), more complex form filling and data processing.

IX. BENEFITS TO VARIOUS POPULATIONS

The benefits of FMP to farmers are clear as already explained. The same is true for other e-Services including e-Gov. and e-Health. Many governments invested a lot in e-Gov. applications during last few years. However, the adoption, especially by BOP, has been very low as most BOP do not have computers, are illiterate, fearful in using a computer, hesitant or not encouraged to go to rural computer centers and the like. It is important to note that e-Gov. applications can serve in 3 major ways:

a. government to business,
b. government to government and
c. government to citizens.

The first 2 have been much more successful than the 3rd case. But, in general, the 3rd case (i.e. effectively communicating with the citizens, dominated by BOP in underdeveloped and developing countries) is more important as such citizens need more help. E.g. many jobs are posted on an e-Gov. website but BOPs do not know about it as they have neither access to it nor they have the knowledge / capability to use it.

The same is true for e-Health. In this case, even many literate people cannot use such services. This is true even in an advanced country like US – most people are literate by the definition of "literacy". But, in general, one would need lot more knowledge and understanding to successfully use on-line e-Health/medical applications.

Intelligent Internet (IINT) will enable all BOPs to enjoy all the key benefits of the Internet and information Age and directly impact their economic, social, cultural and other developments.
They will be part of the digital society and will contribute significantly to the world. It will help eradicate poverty, push them to prosperity and help minimize the rich-poor gap. It will help achieve United Nation's MDGs (Millennium Development Goals). It will also help the rich as they will get low cost enormous resource from the BOPs i.e. have-nots.

And as already mentioned, even highly educated, knowledgeable and Internet savvy people will find a Q&A like application using IINT very useful. E.g. one would be very happy if she/he can get only 1 or 2 correct results from search instead of getting many results.

Additionally, the overall capabilities of the Internet will be enhanced significantly. Users will be able to get lot more useful information much faster (e.g. short summary of several papers, news or books; analysis reports e.g. for Business Intelligence [BI]; or quick answers to many questions and the like). Several Big Data (unstructured & structured) issues will be addressed via Semantic Compression. It will expedite the **transformation from Information Economy to Knowledge Economy to Intelligence Economy.**

X. CONCLUSION

We have presented a new concept of Intelligent Internet (IINT) to transform today's Internet into an Intelligent Internet that can be easily used by all people – literate, semi-literate and illiterate – in much more useful, effective and valuable ways. The key idea is to use a Semantic Engine that can help understand a question asked by a user, generate a short appropriate or best answer, and then deliver it to the user – like a Question & Answer (Q&A) system. Intelligent Agents are used to perform all necessary tasks once the question is understood.

IINT concept is then applied for farming using a Farming Mega Portal (FMP). **Improved farming** for the farmers is the key for their survival and development. FMP (based on e-Farming) meets all the key criteria needed by the farmers (and BOP), namely, Bridging the Digital and Language Divides by using a ubiquitous and affordable device like a simple phone, Using voice and natural language for interaction as many farmers are illiterate, Focusing mainly on "informal education" as farmers would need something affordable, simple and quick that would help them immediately & efficiently, Focusing on some good "Automated Method" to ensure that content type, delivery, usage and learning are

simple, natural & easy, and Focusing on Innovation and Entrepreneurship as these are critical to ensure development with sustainability and growth.

Our proposed solution using **Voice Internet Intelligent Agent based FMP** would effectively meet above needs, and hence would be a good, affordable and practical solution as well supported by the existing users of Voice Internet.

The concept of FMP can be applied for many other applications including e-Health, e-Gov and e-Learning.

The FMP and IINT concepts are even good for highly educated, knowledgeable and Internet savvy people as they will find a Q&A like application very useful. E.g. one would be very happy if she/he can get only 1 or 2 correct results from search instead of getting many results.

Additionally, the overall capabilities of the Internet will be enhanced significantly. Users will be able to get lot more useful information much faster (e.g. short summary of several papers, news or books; analysis reports e.g. for Business Intelligence [BI]; or quick answers to many questions and the like). It will expedite the transformation from Information Economy to Knowledge Economy to Intelligence Economy.

Thus, Intelligent Internet will take Internet to a new level and will allow all users (old and new) to enjoy the existing & new benefits of the Internet and affect their lives **in a positive way with Economic, Social, Cultural and other developments globally in harmony with poor and rich.**

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