

Recent Trends of Research in the Field of Computing Sciences and Informatics

Gerard Deepak¹ Sheeba Priyadarshini² Navya Prakash³

¹Department of Computer Science & Engineering

^{2,3}Department of Computer Science

¹University Visvesvaraya College of Engineering ²St. Josephs College ³University of Mysore

Abstract—Research is an integral part of an academic institution, industry and R& D laboratories. Research and Innovations lead to the development of Technology and in turn contribute the Countries Economy and tends to improve the living standards of the people and henceforth accelerates the upliftment of the Society. For conducting good research, researches must be aware of several domains of research and possibilities for research under a topic of research. In order to promote research, several a research domains that have a lot of scope for research are discussed in the field of Computing and Informatics. Petro Informatics, Geo-Informatics, Computational Biology, Chem Informatics, Green Computing, SMAC/SWIMAC technology stack, IOT, Social Computing, Information Technology and Society are discussed as potential research domains and promote the scope for research in these areas.

Key words: Computational Biology, Chem Informatics, Green Computing, Geo-Informatics, IOT, Petro Informatics, ResearchTends SMAC, Social Computing, SWIMAC

I. INTRODUCTION

With the applications of Computer Science and Informatics in almost every field in the present day modern world, there is a need for every other researcher to understand the booming fields of research in these newly growing areas. For conducting research in a specific area, there is a need for vital knowledge of the background of the field and area of research. There was a term called “Computerization” in the recent past that influenced almost every part of the world but the trend in India started around the early 90s and continued to the next decade where the term meant replacing the manual file system into a highly efficient database management system in almost every field.

Today almost every sector is computerized. In the present day times, where Technological Advancements are to its peak, one can definitely say that each technology has a life span until the next better technology over rides the current existing technology. From this we can infer that not just introduction of technology into a specific field is sufficient but keeping track of technological optimizations and improvising an existing technology by adding more features in mandatory.

To keep in pace with the growing technological advancements, a high quality research needs to be conducted in almost every existing field. Research conducted must be of a high quality and must provide better dimensionality for improvisations. Several kinds of research can be conducted namely academics oriented research, applications oriented research, industry inclined research, etc. A good research leads to much scope for the future generation to concentrate on and definitely a good research is described as the impact of the research conducted on the Society.

Technology and the Society is by itself the domain of interest research. The level of contribution of a particular

research work pertaining to a domain must have a high impact of optimism on the society. In simple terms, a research work must have positive impact and must be constructive to the society and the global economy.

To focus on good research, the research areas or the domain of research interest must be well known to the young budding researchers as well as the highly experienced researchers. My observation in the recent past of research conducted by a researcher is only pertaining to a specific domain. Most of the researchers especially the academic researchers are cozy and comfortable exploring problems into a specific domain. They tackle problems pertaining to their domain of interest and are not ready to consider much relevant problems which are slightly interdisciplinary.

Evaluating the reasons tackling research problems in a single area of research by a researcher the following inferences can be made:

- The researcher is not knowledgeable about closely related domains pertaining to his/her domain of interest.
- Researchers do not want to take risks outside their domain.
- Lack of intrinsic Motivation to take risks.
- Lack of knowledge for application of problems in closely related domain of research.

In order to overcome the problem of insufficient knowledge for applying into a specific domain of research, areas of research must be studied carefully. This paper presents the advances of new research areas and predominant research problems that can be tackled in the newly prominent areas of Computer Science, System Sciences, Computing Advancements, Informatics and all branches related to information technology.

A. Motivation:

A need to know various newer trends in the research specifically in the field of Computing Sciences and Informatics to conduct the best in-class research with a maximum scope especially in the newer areas of research is the motivating factor behind this paper.

B. Contribution:

Several research domains that are rare in the field of informatics is discussed to understand them for conducting good quality research. Domains like Petro Informatics, Geo-Informatics, Chem Informatics, SMAC/SWIMAC technology stack, IOT, Bio Informatics are analyzed and put forth in the paper to incline young and energetic minds for research in these areas.

C. Organization:

The organization of this paper is as follows. The Section 2 describes the related research work. Section 3 presents the Trends in Research. The Survey and Analysis is discussed in

the section 4. Finally, the paper is concluded in section 5 much before the acknowledgement in Section 6.

II. RELATED WORKS

As for related work is considered, an example for at least on work in every mentioned field is considered in order to justify the proposed domain of research already has a scope for conducting comprehensive and prospective research.

Sheng et al., [1] have used statistical tools and computational methodologies for analysis of metabolomics data which are small molecular metabolites. This is an evidence of using computational algorithms in molecular biology thus showing an evidence of research in Computational Biology.

Tang et al., [2] have analyzed the conditions of the flow of debris based on simulation of hydrology response which involves the incorporation of Information Technology into the areas of Geology and Remote sensing which constitutes Geo-informatics as a potential branch for research.

Gerard et al., [3] have proposed the enhanced SMAC technological architecture as SWIMAC architecture to depict architectural organization for Supreme Digital technology for providing a collaborative platform for Infrastructure Business Solutions. This justifies that SMAC and SWIMAC are complementing areas of research that is booming in the recent past.

Chiranjeevi M [4] gives the various applications of Information technology in the Petroleum Industry specifically in the areas of upstream, midstream and downstream for promoting the Oil and Gas Business and achieving high efficiency and productivity by incorporating IT Services. This paper lays a basis for Petro Informatics as a separate Business Domain.

III. TRENDS IN RESEARCH

There are several broad areas of research in Computing. Trends like Cloud Computing, Pervasive Computing, Data Mining, etc are current areas of research which are almost becoming very common. Most of the researchers are conducting areas on these areas. Sooner, these areas of research will become saturated and redundant as most of the research areas happen. The main objective of this paper is not to discuss the common areas of research with focus on problem solving with various applications rather our main focus is to introduce newer areas of research with higher level of prominence for carrying out research with a distinctive mindset and ideology. The budding areas of research in informatics and Computing are discussed below:

Petro Informatics is the multidisciplinary domain of research which is the incorporation of Information Technology in the field of Petroleum Extraction, Processing and Refining. Petro informatics has been introduced for the process of oil extraction and refining assisted using information technology.

The incorporation of information technology in petroleum extraction can be done at any specific stage of petroleum extraction. The research possibility may be as simple as automating the process of petroleum oil extraction by designing remote robots for controlling the operation of drilling. Not just controlling the drill but also deciding the

speed of penetration and the depth of penetration can be automated. A special data analysis and mining technique of already available historical data can be used to decide the speed and the depth for penetration of the drill. A petroleum Geographical Information System (GIS) can be designed as an expert system for directing the Geographical locations for petroleum extraction. Application of Computing Paradigms for purification and refining of petroleum crude oil, ie, controlling without the intervention of human decisions based on neural networks and decisive computing can also be a promising area of research in petro informatics.

Green Computing is a strategy of computing which promotes and emphasizes on ecofriendly means of computing. Green computing includes several factors that needs to be considered and it may include effective designing of the Hardware, disposal of e-wastes in a non-hazardous manner, usage of optimum power and necessary resources for computing, algorithm optimizations to yield better throughput and dissipate less heat energy to the environment, efficient recycling of e-wastes, etc. fits into the concept and research areas of Green Computing. Green Computing can also be termed as Environmental Friendly Computing or Eco Friendly Computing. Research in the above mentioned areas can be conducted which would impact a lot on the environmental benefits and be advantageous to the society on the whole.

Information Economics is the study of how information as well as information systems influences and affects the global economy and hence forth the economic decisions. The present age is the information age where Information is considered to be Knowledge and Knowledge is power which is in turn wealth. Computing in the era of information is definitely an added advantage for Knowledge Mining where the knowledge that is in most demand attracts wealth henceforth giving birth to a newer domain "the economics of information". The Information Economics gives rise to several newer research domains like information marketing, accounting for information, Furthermore Contract Theory and Information Asymmetry and Game theory to study the economics of information are the budding domains of research. Although Information Economics in informatics is quite a recent advancement, there are several metrics to measure the type of information and analyze the information and its uses for application into several domains.

Internet Mathematics is a newer branch of Computational Mathematics which was developed with the recent advancements in the Internet and Web Technologies. The World Wide Web is a collection of several sites and a lot of information in a highly random manner but indexing the web page and also linking the web pages reasonably together to understand their pattern of retrieval involves a lot of computations henceforth giving rise to a newer research domain called the Internet Mathematics. The linking of Web Pages across the world wide web can be modeled as a collaborative connected graph, thus the analysis of such links and ties between the web pages and domain of the web involves Graph Theory and also a fewer concepts of Combinatorics. Probabilities and Statistics plays a vital role when computing and estimating the predictions of the web search and also the precision and recall calculation of web mining algorithms, several predefined statistical processes

and methodologies comes in picture thus including them in Internet Mathematics. While considering with the Semantics of the Web, a of reasoning and logic has to be deduced among the individuals in the ontology constituting the Web Semantics, thus Group Theory and Discrete Mathematics is a part of Semantics of the Web which in turn can be constituted as a part of Internet mathematics.

Chemical Informatics or Chem Informatics or Chemo Informatics is the application of information technology and computational engineering in the fields of pure and applied chemistry and chemical engineering to achieve a better outcome in every possibility of experimentation, application or even a simple study. One of research area in Chem Informatics is constructing a Chemical Bank using Ontologies to develop several sub-domains for a specific set of chemicals as they are studied which makes the study of chemicals much easier. An Expert System can be designed for the use of chemicals, ie, the concentration of chemicals, their use, their properties, nature, etc. can be elicited from the Expert System. The chemical reactions can be monitored using computational systems which can be developed using various sensors such that the chemical reaction rate, spontaneity, their feasibility, analysis of chemical reactions can be done automatically rather than conducting them manually thus also facilitating remote monitoring of the chemical reactions which would automatically redefine the nature of the conduct of chemical reactions with a lot of accuracy to give rise to a number of promoted research in this field. Another booming research in the area of Computational Chemistry is the Modeling of Chemical Structures. Though Structures for most of the chemicals exists, modeling was done manually using several kinds of software. The modeling of chemical structures can be automated by incorporating artificial intelligence to derive the API of Modeling Chemical Structures which is another mentionable area of research in the field on Chem Informatics.

Computational Biology [5] sometimes referred to as Bio Informatics is the application of Computational Engineering and Information Technology in the pure and applied areas of Biology to achieve robust results on their experimentation, design and automation of several processes. Although Bio Informatics and Computational Biology are synonymous terms, there is a slight degree of variation between the two but they almost correlate to similar application when considered as a whole. Several areas of research exists in the field of Bio Informatics and a few of them may include analysis of medical images, ie, medical image processing in order to draw conclusions based on a training set of similar data by predictions, inferences and outlier detection mechanisms.

The incorporation of Image Processing in the field of Medical Imaging and Radiology to conclude on results without the influence or the presence of a certified Radiologist with high level of accuracy resulting in a newer area of research called the Computational Radio-diagnosis or Computational Radiology. Another notable research area in Computational Biology is the Computational Genomics which involves the usage of computational algorithms for DNA profiling, DNA sequencing and Gene Analysis to infer any aberrations, changes or also predict the genomic mutations in the far and near future. This further gives rise

to constructing Genomic Ontologies, Online Gene Bank and Gene Modeling and Reconstruction which have several vital applications in the field of Genetics. Another subsidiary research area is the Computational Molecular Biology or Molecular Informatics where the molecular level of the Gene constituents or any life constituent at molecular level is studied, analyzed and modeled using algorithmic principles and principles of AI thus giving rise to construction of Molecular Banks and Structures for future references and study.

The latest application of Computational Biology is in the field of Medicine where a Distributed Expert System to treat patients is engineered based on analysis of historical treatments by the systems using intelligent agents and principles of data classification and analysis thus enabling a physician free treatment drug discovery thus laying a basis for Medical Informatics or Med Informatics. The drug and medicine information also needs to be modeled also giving rise to a newer branch which is synonymous called the Pharma Informatics. Additionally, Computational Neurosciences is another booming area of Computational Biology where the Neural Network Algorithms, Decision Making Algorithms and Genetic Algorithms are integrated together in order to develop artificially intelligent computing systems with the capability of decisiveness as per the human brain. Computational Neurosciences is still in its conception stage as its highly difficult to simulate a decision pattern of a human brain but an attempt is done to implement it in computing systems to achieve the best in class performance of the Expert Systems similar to that of a human brain.

Geo-informatics [6] is the amalgamation of Earth Sciences with Information Technology. Geo-informatics has several applications and research domains. To mention a few, analysis of Spatial Images and Geo Information, Soil Classification and Topology classification based on Image Processing or Geo-information mining, Remote Sensing using Information Technology, Predictions of Earthquakes and Natural Calamities based on historical data analysis with the dynamic Geo Information of a specific area, Cartography using Computational Techniques, etc. are a few areas of research in the domain of Geo-informatics.

Social Networking with the boom in several social networking sites gives rise to several mentionable domains of research. First of all Social Network Mining is an area that is in demand where the data from social network is extracted and analyzed using statistical tools and procedures in turn analyze friendship patterns, social relationships, community interest ,etc. Social Network Mining further lays a foundation for Social Information Forensics where the data from social networking sites is analyzed, outliers are found out to investigate crimes, fraudulent cases, etc. Study of several social trends gives a research domain for social anthropology where the social behaviors of social networking participants can be analyzed quite easily and efficiently. Social Marketing or Digital Marketing is another important trend of social networking that also becomes another research domain for information technology and management.

Internet of Things (IOT) is another novel strategy for connecting several real life things and govern computing in a way such that to facilitate remote monitoring of objects functioning and processing. IOT deals with connecting any

real world existing thing, It can be connecting several computers or connecting practical things like cars, connecting a robot or connecting devices like TV, refrigerators, washing machine, other home appliances or even connecting data centers, cloud etc. to the internet and centrally monitor all of the connecting things or automate their functionality creating a smart connected world. IOT is the next smart revolution in the area of research in the field of Computing, Informatics and Communication Engineering for achieving a smart world with the most advanced technologies.

SMAC Stack Technology is the Digitalization Model of several Technologies that integrates Social Networking, Mobility, Analytics and Cloud and proposes a new Business Infrastructure for achieving a high degree of productivity in delivering Infrastructure Business Services to the clients in a highly organized manner to elevate the business towards a NextGen level. The Enrichment of SMAC stack is the SWIMAC Technology where individual SMAC technologies are powered by Internet of Things (IOT) and Semantic Web Technology in order to enhance the business infrastructure of the SMAC Stack Technology to the next higher level and in turn redefine digitalization technology as the high end Supreme Digitalization Model. Both SMAC and SWIMAC technologies are potential domains for conducting research in the field of Business Informatics. Also, Warehouse Computing which includes Constructing the Data Warehouse and Knowledge Mining from the Enterprise Level Data Warehouses for achieving Business Intelligence is another prospective domain that fits into Business Informatics to conduct comprehensive research.

Information Technology and Society or Informatics of the Society is another research domain where research is being carried out and is of high importance because it relates both Information Technology and The Society which definitely will be beneficial to the society. It's already a research domain in IIIT-B [7] where research on public policy, e-governance, spatial information sciences, etc. is carried to for the benefits of the society.

IV. SURVEY AND ANALYSIS

A survey was conducted amidst multidisciplinary research groups through e-mails, social networking sites and a few also in person. Almost 72 professionals in academic as well as industry oriented research were involved to give their opinion about various research domains and how would research boom in that domain in the next five years. The results were quite surprising and to summarize them as a bar chart, the results are depicted in the Figure 1.

The participators in the survey who are either budding or established researchers have voted for 45% impact factor for Petro Informatics as a Research Domain while Green Computing would have an impact of 55% from the surveys result. However, Information Economics spans only for a 42% impact in the next five years as a research Domain. Computational Biology scores 84% impact as a standalone research domain from the survey participators. SMAC/ SWIMAC technology as a separate individual research domain attracts 72% impact in the next five years as a separate domain for research.

Internet of Things (IOT) has an estimated impact of 80% as per the survey results. Social Computing scores the highest of 94% impact and is the highest among all the individual research domains. The primary reason for this could be the recent trend and success of Social Networking Platforms. Geo Informatics however gets a predictive impact of 48%. Information Technology and Society gets estimated impact of 88% for next five years owing to the fact that technology highly influences the society and good reach must meet to the needs of the society.

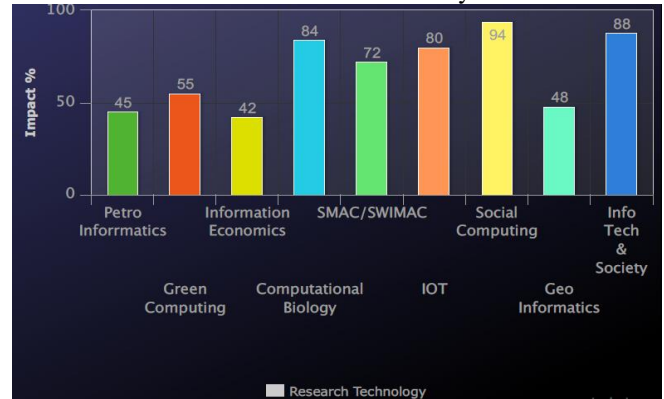


Fig. 1: Research Technology-Impact Distribution

V. CONCLUSIONS

Research is the key force to drive an organization, govern technological advancements and in turn gear the economy of the nation to make the global world and the society a better place to live. In this paper, the most rare and budding research domains which would have a very high impact in the near future is discussed in the fields of Computing Sciences and Informatics. Several domains and sub-domains of research which is budding and providing a platform for research is discussed in the paper to motivate young researchers to choose a domain of their interest and to contribute to the future and good of the society by conducting prospective research which would have a positive impact and an optimistic approach.

In this paper, either the not so popular yet highly useful research domains are discussed or a research domain which would create a very high impact is brought to light. Domains like Petro Informatics, Social Networking or Socio Informatics, Computational Biology, Information Economics, Green Computing, Geo-Informatics, Chem Informatics, Internet Mathematics, SMAC and SWIMAC technology stacks are discussed in depth with a fair description of several research problems or applications promoting the possibility for research.

REFERENCES

- [1] Sheng Ren, Anna A H, Emily L K, Rhonda D S and Long J Lu, "Computational and Statistical Analysis of Metabolomics Data," in Springer Science + Business Media New York Metabolomics, 2015.
- [2] Jiafa Tang, "The Analysis of the Initiation Conditions of the Debris Flow in the Jiangjia Ravine Based on the Simulation of the Hydrology Response," in International Symposium GMRSE, Nov 2013, Wuhan China, Proceedings Part 2 pp. 663–676.
- [3] Gerard Deepak, Navya Prakash, Md. Zakhir Ameen and Dheera Kasaraneni, "SWIMAC: Enhanced SMAC

- Architecture for Business Solutions in Digitalization of IT Infrastructure Services,” in International Journal of Advanced Research in Computer and Communication Engineering Vol. 4 Issue 10.
- [4] Chiranjeevi M “Information Technology (IT) Applications in the Petroleum Sector,” in Recent Advances in Information Technology (RAID), 2012.
- [5] Wikipedia Article, “Computational Biology,” https://en.wikipedia.org/wiki/Computational_biology, Last Accessed on 30 Oct 2015.
- [6] Wikipedia Article, “Geo informatics,” <https://en.wikipedia.org/wiki/Geoinformatics>, Last Accessed on 30 Oct 2015.
- [7] Online Article, “Information Technology and Society,” <http://www.iiitb.ac.in/research/information-technology-and-society>, Last Accessed on 30 Oct 2015.

