

One of the Four Winners to A-Star's Call for Ideas 2013

OSMIND: Outstanding Sense-making Mind

(Proposals should not be more than 3 pages ~ 1500 words)

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*(The above information will allow A*STAR to contact you regarding the prize should your proposal be selected as a winning idea)*

(A) Challenge Overview

In a world defined by rapid scientific breakthroughs and technological advancements, to be able to spot opportunities and, marshal resources and talent directed at them is a big competitive advantage.

This challenge calls for big opportunities/areas in Science and Technology that would deliver impact to the economy, sustainability or healthcare.

As significant resources is expected to be committed (\$50Mil and more) to the selected area, submissions should be ambitious but have achievable goals, are bold in terms of a plan to reach peaks of excellence internationally and clearly demonstrate the differentiated and comparative advantages that Singapore R&D performers have in the area. It is necessary that submissions must be intrinsically multi-disciplinary and preferably, multi-institutional.

Entrants can draw references from investments made in stem cells or Maritime and Offshore Programme as examples of the nature of ideas for R&D investments that this call seeks to solicit. In both examples, international visibility, economic competitive or healthcare benefits were key outcomes.

(B) Challenge Process

The challenge will open on 6 May 2013 and close on 5 June 2013. After the Challenge deadline, A*STAR will review and inform the entrant(s) of the Winning Idea(s). All entrants who have submitted a proposal will be notified on the status of their submissions; however, no detailed evaluation of individual submissions will be provided.

The award(s) will be paid to the best submission(s) as solely determined by A*STAR. Each winning idea will be awarded SGD\$5,000.

The entrants agree to grant A*STAR the right to use the winning ideas and any information submitted in relation to such ideas for other A*STAR initiatives including but not limited to themes for future calls for proposals in any other competition.

(i) Analysis of Idea

This section should describe the idea, desired outcomes and its benefits to Singapore and beyond. The timeframe to impact as well as the applicability of the idea to meet future challenges should be articulated. Potential challenges and constraints should also be highlighted.

OSMIND: Outstanding Sense-making Mind

The last major frontier in science and technology is the science of brain and mind. The new discovery and invention in this field will revolutionize the whole world with newer and smarter products and machines which could enhance the quality of people's lives in all domains.

However, over the past 60 years, there have been many attempts aimed to develop various principles, solutions and techniques under the title of artificial intelligence. However, most of the attempts, if not all, fall into the paradigm of computerizing human intelligence. Obviously, computer-aided human intelligence has little to do with (human-like) machine intelligence (i.e. intelligence engendered by a machine itself). Most importantly, it is logic to say that computerizing human intelligence will never lead to any actual progress toward (human-like) machine intelligence which could autonomously grow through the interaction in a dynamic environment.

In view of this deficiency, we propose this project with the aim to develop new engineering principles and solutions which could enable a computer, a robot or a machine of any kind to possess human-like mental ability in autonomous learning, perception, understanding and sense-making.

In particular, we propose a meaning-centric framework to develop cognitively intelligent sense-makers which will possess two most important mental abilities, namely: a) cognitive vision, and b) cognitive linguistics. We believe that these two mental abilities of a sense-maker, a robot-like machine or a robot-like product of any kind will be indispensable for it to naturally act or interact with human masters or players, in many emerging applications (e.g. gaming).

Engineering research aims at inventing physical systems or machines (e.g. robots) which could extend human being's abilities in various domains in order to enhance our efficiency and supremacy in the world. So far, human beings have achieved the astonishing results in extending the physical abilities such as mobility (or locomotion), manipulation, handling, manufacturing (i.e. making things by hands directly or indirectly), construction, agriculture, medical intervention, etc. The next wave of astonishing achievements will certainly be in the area of extending human being's mental abilities. We hope that OSMIND project could contribute toward this direction in one way or another.

In particular, we believe that any significant outcome from OSMIND project within a

timeframe of five years will have astonishing impacts for many interesting applications such as:

Newer and Smarter Products of Any Kind: With cognitive vision, a machine of any kind or a robot will be able to see. For example, future cars, which could see the roads, will be much safer than those could not. With cognitive linguistics, a machine of any kind or a robot could undertake conversational dialogues with human masters. This opens the doors to the emergence of home robots which will be able to provide different kinds of assistance to elderly, housewives, children, etc.

Interactive Media and Future Operating Systems: Interactive media represent a big market for IT industry. Today's interactive games rely on signals to trigger, engage and synchronize actions and interactions. This mode of interaction makes the responsiveness of games less natural. With cognitive vision and linguistics, the interactive games of tomorrow will be able to see, and talk with, human players in a natural way. On the other hand, today's operating has no intelligence and is mindless. OSMIND will be a disruptive product, which will enable truly intelligent operating systems to emerge.

Automatic Creation of Multimedia Contents: Films, videos, and online courses are some typical examples of knowledge-based products in consumer market. However, their production is highly manual and labour-intensive. If a computer of tomorrow could master human languages which are the common way of representing knowledge, it will be possible to automate the production process of films, videos, and online course, etc, from the input of monographs.

Machine Translation: With cognitive linguistics, a hand-held device could become a multi-lingual translator, which will certainly help preserve the social and cultural cohesion in the world while promoting globalization and tourism.

Many other exciting applications include automatic modelling and simulation, eLearning, Web services, visual surveillance, homeland security, defence, etc.

(ii) Analysis of Capability Levels

This section should include a stocktake of existing R&D efforts and capabilities in Singapore that could be leveraged upon in the area identified. A description of the new capabilities that would be developed should be presented as well.

The world is a complex system which is well organized. The vertical integration of a complex system occurs at three levels such as materials, devices and systems. At the highest level, it is software. And, in particular, it is the software with intelligence such as OSMIND, which will have the potential to dominate the world market in all domains which range from finance, management, economics, science, engineering, education, industry, manufacturing to medical services and cares, etc. Singapore is well-positioned in undertaking software related research and development. OSMIND is highly focused on the breakthroughs in brain science and the engineering principles of artificial mind. OSMIND project provides a solid base to support the wider participation from Singapore-

based institutions and researchers, which include: NTU, NUS, I2R, SimTech, Institutes of Neural Sciences, Medical Schools, Business Schools, Polytechnics, ST Engineering, Singapore Power, SingTel, Singapore Airlines, Hospitals, Agency for Integrated Care, MINDEF, DSTA, DSO, Port Authority, etc.

(iii) Analysis of Competitive Advantage

This section should provide an analysis of the existing key leaders and competitors in the field. Emphasis should also be placed on Singapore’s differentiating advantage and value proposition and how this would allow us to leapfrog the incumbent and gain leadership position globally.

Interestingly, European Union has announced a human brain project (HBP) in 2012. The aim is to build a new ICT infrastructure and to simulate the functionality of human brain with the hope of discovering the working principles of human brains. The funding allocated to this initiative is 1.2 billion of Euro. In 2013, President OBAMA of USA has announced the national brain project with the coordinated efforts in USA. With billions of dollars of investment, the aim is two folds. On one hand, it is to better understand the functionality of human brains so as to find effective treatments of brain-related diseases. On the hand, it is to discover the principles of human mind so as to advance the theory of artificial intelligence. Therefore, it is clear that both Europe and USA has recognized the fact that the last and major frontier in science and technology is the brain science.

In contrast, there is no announcement in Asia with clear objective to tackle the challenging and complex issues of brain science. As a result, Singapore should take this opportunity to venture into highly significant and beneficial journey toward the advancement of brain science and applications of mind-inspired principles to support innovations of smarter products and smarter services in all domains. As shown in the diagram below, Singapore’s researchers (Ming Xie et al from NTU) are leading the research and development in artificial intelligence:

