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Analysis and modelling of strong-AI to engineer BIONIC brain for humanoid robotics application

Md. Sadique Shaikh[1], Vasundhara Fegade[2]

[1]Department of Computer, Arts & Science College, Bhalod, M.S, India
[2]Dept. of Computer, D.N. College, Faizpur, M.S, India

Email address:
sids_nsk@rediffmail.com(Md. S. Shaikh)

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Abstract: In my research very first I was gone through the literature surveys, history of AI and Robotics from various secondary data and information sources like white papers, short essays, research papers, research review papers, newspapers, monographs and standard reference books in the field of AI, robotics and humanoid robotics. I was collected and refine data and re-refine until data changed to information, where I was further filtered information to convert in intelligence to develop most sophisticated Humanoid Robotics engineering models as my contribution to this field with the help of my carried out research work in this paper.

Keywords: Artificial Intelligence, Thinking Machine, Strong-A.I, Robotics Engineering, Humanoid Robotics, Neurosciences, Neural Network, Artificial Neural Network (ANN)

1. Artificial Intelligence

Although Artificial Intelligence is one of the newest fields of intellectual research, its foundations began thousands of years ago. In studying Artificial Intelligence, it is useful to have an understanding of the background of a number of other subjects; primarily philosophy, linguistics, psychology, and biology. Perhaps a better starting point would be to ask, "What is intelligence?" This is a complex question with no well-defined answer that has puzzled biologists, psychologists, and philosophers for centuries. One could certainly define intelligence by the properties it exhibits: an ability to deal with new situations; the ability to solve problems, to answer questions, to devise plans, and so on. It is perhaps harder to define the difference between the intelligence exhibited by humans and that exhibited by dolphins or apes. For now we will confine ourselves, then, to the somewhat simpler question that: What Is Artificial Intelligence? A simple definition might be as follows:

Artificial intelligence is the study of systems that act in a way that to any observer would appear to be intelligent.

This definition is fine, but in fact it does not cover the whole of Artificial Intelligence. In many cases, Artificial Intelligence techniques are used to solve relatively simple problems or complex problems that are internal to more complex systems. For example, the search techniques are rarely used to provide a robot with the ability to find its way out of a maze, but are frequently used for much more prosaic problems. This may lead us to another definition of Artificial Intelligence, as follows:

Artificial Intelligence involves using methods based on the intelligent behavior of humans and other animals to solve complex problems.

Some systems that are able to "understand" human speech, or at least are able to extract some meaning from human utterances, and carry out actions based on those utterances. Such systems may not be designed to behave in an intelligent way, but simply to provide some useful function. The methods they use, however, are based on the intelligent behavior of humans. This distinction is brought into sharper contrast when we look at the difference between so-called strong AI and weak AI. The followers of strong AI believe that by giving a computer program sufficient processing power, and by providing it with enough intelligence, one can create a computer that can literally think and is conscious in the same way that a human is conscious. Many philosophers and Artificial Intelligence researchers consider this view to be false, and even ludicrous. The possibility of creating a robot with emotions and real consciousness is one that is often explored in the realms of science fiction but is rarely considered to be a goal of Artificial Intelligence. Weak AI, in contrast, is simply the view that intelligent behavior can be modeled and used by computers to solve complex problems. This point of view argues that just because a computer behaves intelligently does not prove that it is actually intelligent in the way that a human is.

1.1. Strong Methods and Weak Methods

We have discussed the difference between the claims of weak AI and strong AI. This difference is not to be confused with the difference between strong methods and weak methods. Weak methods in Artificial Intelligence use systems such as logic, automated reasoning, and other general structures that can be applied to a wide range of problems but that do not necessarily incorporate any real knowledge about the world of the problem that is being solved. In contrast, strong method problem solving depends on a system being given a great deal of knowledge about its world and the problems that it might encounter. Strong method problem solving depends on the weak methods because a system with knowledge is useless without some methodology for handling that knowledge. The earliest research in Artificial Intelligence focused on weak methods. Newell and Simon's General Problem Solver (GPS), was an attempt to use weak methods to build a system that could solve a wide range of general problems. That this approach ultimately failed led to a realization that more was needed than simple representations and algorithms to make Artificial Intelligence work: knowledge was the key ingredient. In many situations, weak methods are ideal for solving problems. However, the addition of knowledge is almost always essential to build systems that are able to deal intelligently with new problems; if our aim is to build systems that appear to behave intelligently, and then strong methods are certainly essential.

1.2. AI and Humanoid

Scientists are beginning to look much more closely at the mechanisms of the brain and the way it learns, evolves and develops intelligence from a sense of being conscious (Aleksander, 2002). For example, AI software designers are beginning to team up with cognitive psychologists and use cognitive science concepts. Another example centers upon the work of the 'connectionists' who draw attention to computer architecture , arguing that the arrangement of most symbolic AI programs is fundamentally incapable of exhibiting the essential characteristics of intelligence to any useful degree. As an alternative, connectionists aim to develop AI t rough artificial neural networks (ANNs). Based on the structure of the nervous system, these 'computational-cognitive models' are designed to exhibit some form of learning and 'common-sense' by drawing links between meanings (Hsiung, 2002). ANNs,then, work in a similar fashion to the brain:as information comes in, connections among processing nodes are either strengthened (if the new evidence is consistent) or weakened (if the link seems false) (Khan, 2002).The emergence of ANNs reflects an underlying paradigm change within the AIresearch community and, as a result, such systems have undeniably received much attention of late. However, regardless of their success in creating interest, the fact remains that ANNs have not nearly been able to replace symbolic AI. As Grosz and Davis (1994) remark: *'[Symbolic AI has] produced the technology that underlies the few thousand knowledge-based expert systems used in industry today.'* A major challenge for the next decade, then, is to significantly extend this foundation to make possible new kinds of high-impact application systems. A second major challenge will be to ensure thatAI continues to integrate with related areas of computing research and other fields(Doyle and Dean, 1996). For example, the kinds of developments described in Section 2for nanotechnology may go some way to accelerating progress in AI, particularly through the sensor interface. For these reasons, the list of main research areas that follows should be regarded as neither exhaustive nor clear-cut. Indeed, future categorizations will again change as the field solves problems and identifies new ones.

1.3. Learning

According to Daniel Weld (1995) of theUniversity of Washington, machine learning addresses two interrelated problems: 'the development of software that improves automatically through experience and the extraction of rules from a large volume of specific data.' Systems capable of exhibiting such characteristics are important because they have the potential to reach higher levels of performance than systems that must be modified manually to deal with situations their designers did not anticipate (Grosz andDavis, 1994). This, in turn, allows softwareto automatically adapt to new or changing users and runtime environments, and to accommodate for the rapidly increasing quantities of diverse data available today. When designing programmers to tackle these problems, AI researchers have a variety of learning methods at their disposal. However, asalluded to above, ANNs represent one of the most promising of these.

1.4. Artificial Neural Networks

There are many advantages of ANNs and advances in this field will increase their popularity. Their main value over symbolical systems lies in the fact that they are trained rather than programmed: they learn to evolve to their environment, beyond the care and attention of their creator (Hsuing,2002). Other major advantages of ANNs lie in their ability to classify and recognize patterns and to handle abnormal input data, a characteristic very important for systems that handle a wide range of data. Furthermore, many neural networks are biologically plausible, which means they may provide clues as to how the brain works as they progress. Like the brain, the power ofANNs lies in their ability to process information in a parallel fashion (that is, process multiple chunks of data simultaneously). This, however, is where the limitations of such systems begin to arise: unfortunately, machines today are serial they only execute one instruction at a time. As a consequence, modeling parallel processing on serial machines can be a very time-consuming process (Matthews, 2000a).A second problem relates to the fact that it is very difficult to understand their internal reasoning processes and therefore to obtain an explanation for any particular conclusion. As a result, they are best used when the results of a model are more important than understanding how the model works. To this end, these systems are often used in stock market analysis, fingerprint identification, character recognition, speech recognition, and scientific analysis of data (StottlerHenke, 2002).

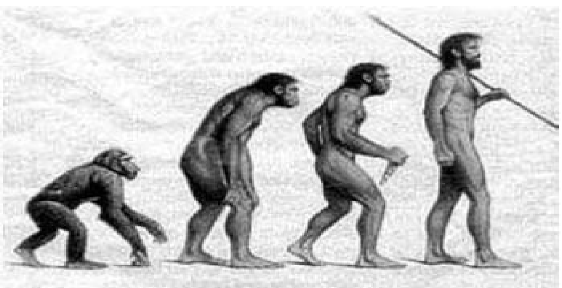
Humanoid Robotics

Once people understand that machine ethics has to do with how intelligent machines, rather than human beings, should behave, they often maintain that Isaac Asimov has already given us an ideal set of rules for such machines. They have in mind Asimov's ‘‘three laws of robotics'':

1. A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the first law.
3. A robot must protect its own existence as long as such protection does not conflict with the first or second law.

On other side Such man describes how the upcoming of "intelligent" objects changes our attitude towards artifacts from passive things to intelligent others. Properties that we would refer to as typically human like emotion, speech and purposeful action, now (at least partially) apply to computers as well. As a consequence, dealing with artifacts becomes a social activity and can be regarded similarly to human interaction. In cognitive science, computers are used to explore human cognition without being restricted to the (scientifically) observable behavior, but with scientific methods. Its basic assumptions are that Mind is an abstract (bodiless) structure that can be implemented in any kind of physical substrate, like a computer, and that people "act on the basis of symbolic representations", that lead to mental states and provide a consistent behavior, And as a consequence, that cognition can literally be seen as, and therefore simulated by, computation.

Human Evolution vs. Humanoid Evolution



2. Analysis and Designing (Modeling)

In my research very first I will go through the literature surveys, history of AI and Robotics from various secondary data and information sources like white papers, short essays, research papers, research review papers, news papers, monographs and standard reference books in the field of AI, robotics and humanoid robotics. I will collect and refine data and re-refine until data changed to information, where I will further filter information to convert in intelligence to develop most sophisticated Humanoid Robots engineering models.

2.1. Basic Humanoid Robot Engineering Model

This is the very first and fresh model about basic humanoid Robot engineering developed on the basis of several gathered facts and strong research analysis in this domain. In this model I proposed four essential parameters to engineered advanced and humanoid machine and named them BODY, SOUL, INTELLIGENCE and ENERGY. You can clearly get understand why I chooses to these four parameters with human being example. We people are very civilized and living organism on earth but why and the answer is because we have physical human BODY in which we have SOUL installed by God and Brain which is biological thinking machine in short INTELLIGENCE but time to time we people need food to reenergizes ourselves with consuming Vegetables, fruits, grains etc. to generate ENERGY within the BODY to execute for whole day. Similarly when you start to thinking about HUMANOID Robotics designing, you also need to consider same criteria being engineering of Human-like artificial machine. I used to terminology BODY in my model with the intension All electronic devices, sensors, actuators, ICs, processors, controllers required in assembly of Humanoid Artificial Body in Short Hardware part required in construction of dead Humanoid body. This body consist on sensor/transducer in Human-like cognitions (vision, touch, smell, speech/voice recognition), Actuator, motors, servo-motors, electro-Mechanical, Pneumatic parts ,valves etc. for Human-like movement, Advanced logic processors/controller based on “Neural Schemas” and function like Artificial brain ,Memories and Mass storage for Human-like data saving , retrieval , processing ,decision-making, information generation and

STM)Short Term Memory) and LTM (Long Term Memory) for memorization.

Second important aspect during Humanoid engineering process is SOUL to make electronic (Hardware) dead body alive could be possible by engineering Advanced Operating System ,Real Time Operating System(RTOS), advanced system drivers and utilities ,Advanced DBMS,DS and information processing algorithms ,Neural Network Schemas ,self-learning algorithms and program developments. Next major issue of Humanoid engineering is INTELLIGENCE which is very broad itself, to implement Human-like thinking ability to control and execute all human processes, topic/jobs using A.I. programs/modules/software's, Neural Networks, Neural Schema's for strong –AI,Genetic algorithms, Advanced logic engineering for pattern /object recognition and translation (Natural Language Processing), readings, facial expression, love and desire and human like response smart programs. The last strong consideration for Humanoid engineering is ENERGY and energy management i.e. how could we able to engineered reliable ,durable ,cost-effective compact ,dense inbuilt energy strong in Humanoid Robots and off course possible using ultra low power consumption CMOS rechargeable batteries and units , highly dense and compact energy strong cells , and possibly Renewable and long lasting energy devices in humanoid.(See annexure-1 for figure).

2.2. Layers Diagram of Humanoid Robotics

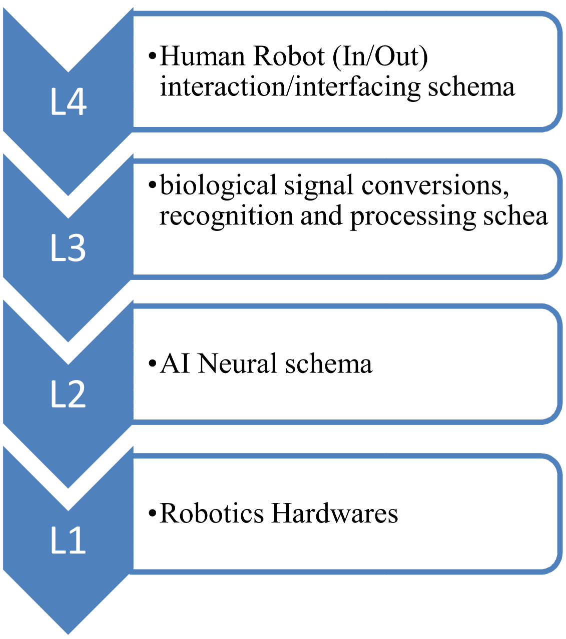


Fig 1: *Layer Diagram of Humanoid Robotics (Source: Prof. Md. Sadique Shaikh.)*

This is second explored model of mine and labeled "Layered Diagram of Humanoid Robotics" In this model major emphasis not on hardware (BODY) ,but Software(SOUL) part and segmented into four layers L1,L2,L3 and L4 with 'Robotics hardware , AI –Neural Schema's , Biological signal conversional, synthesis , recognition and processing schema's and Human-Robots (IN/OUT) Interaction/interfacing Schema's respectively. The basic intension to produce that model is to aware about the fact of intellectuality requirement in humanoid software development ,which is 100 times difficult topic as compare to general users or weak –AI software's development. This model highlighted how one can engineered strong-AI for Humanoid Robotics. We much aware about Robotics Hardware i.e. L1 layer hence I skip it and start to processed from layer L2 i.e. A-I Neural Schema's these are ultra-strong A-I programs or set of program to copy human –like processed since Turning Machine to till the date. Theseschemas are sophisticated and engineered logic for human like Thinking, speech Synthesis and recognition, pattern/image processing (machine vision), precise angular movements, feelings, facial expression, emotions, love, smartness, self -learning, decision-making and so on. But to send data/information up to these schema's layer L3 play very vital role i.e. 'Biological signal conversions, recognitions and processing schema's ' these schema's convert ,identify and process in Humanoid human voice , image/faces, touch smell, text and likewise things, but again to accept all these in electronic data formats from physical and Natural human formats Layer L1 is very important i.e. 'Human-Humanoid Interfacing(HHI)' people often called interfacing or GUI/HCI schema's which accept human input from sensor and transducers and software schema's .These three important layers may engineered as individual schema's or integrated schema's.

2.3. Intelligence System Designing Model (ISDM)

This is third important model modeling based on my research finding in Humanoid. I named this model as 'Intelligence System Designing Model (ISDM)', Name itself suggest this model developed with the intension to give knowledge about for Intelligence System Designing & Development. If we consider to engineered and model system, So it has three major domain for designing i.e. 'Input processes and output 'as shown in model. In input intelligence engineering for Humanoid major emphasis on "Sensation Intelligence Designing" like voice sensing and recognition engineering , Touch Sensing and Recognition Engineering , Image Sensing and Recognition Engineering and Smell & Test Sensing and Recognition Engineering " those are themselves very broad subjects of research and engineering in the field of Humanoid Robotics and are very essential. The next most important and serious issue of engineering is "Intelligence Process and Controls" designing i.e. strong-AI Neural schema's and implementation, most favorable "Bionic (Bio-electronic) Brain", over which I already discussed and wrote. This is the very challenging engineering domain in Humanoid Robotics and example is "ASIMO" manufactured by HONDA one of the successful HUMANOID. The areas of engineering are numerous here but I am giving to enlist some important like ”Arithmetic intelligence engineering , logical Intelligence Engineering ,Reasoning and decision-making Intelligence Engineering , emotion, feelings, expression intelligence engineering as well as self- learning & memorization intelligence Engineering “.The last phase of this system development is Actuation Intelligence Engineering, which really challenging and very interesting algorithm , This is challenging is because of have intelligence computer robotics programs synchronized and execute to Hardware (BODY) of Humanoid and interacting because of we going to give human-like thinking and motions(movements) to machines. This phase also called output system engineering of Humanoid which following important field “speaking/communication intelligence engineering, motion/movement intelligence engineering, folding/Bonding/Joint movement/control engineering and clutching, Climbing, walking intelligence engineering “. The first of field may be increase according to dynamism in Humanoid, but not would be less of this.

2.4. Intelligence Domain Model (IDM) (See Annexure-3 for Figure)

With continuation to all previous engineered models, now I would like to clarify the concept of intelligence domain and according to it type of intelligence and how we able to categorized it . Hence for the answer of all these questions I developed “Intelligence Domain Model (IDM)” I received studies and conformed from various literature source Artificial Intelligence (AI) classified into two types “Weak A.I and strong A.I “, where weak A.I is very poor (low) with intelligence, creating and problem-solving skill as well as completely user’s (Programmers) dependent programming i.e. Autonomy is very low, therefore needs more programming guidelines. Some examples of weak A.I implementation are Microprocessor/Microcontroller based system, smart electronic gadgets, Toy’s, Smart Phone, Kitchen appliances, home appliances like CD-Player, T.V, DVD Players , Microwave Oven, Washing Machine, Refrigerators, Cars, Bikes , and all electronic logic based and control devices , instruments, Automobiles Aerodynamics and so on. Hence in short weak-A.I only suitable for Non- Humanoid Robotics or Industrial Automation/Robotics or Smart consumers electronic appliances, gadgets and so on. Here is intelligence exist but not suitable for Humanoid , because weak-A.I only the engineering of some functions and processes of Natural brain, but not complete human brain i.e. Natural Intelligence copied on silicon wafer i.e. electronic data processor (EDP) with some function of brain. But for Humanoid Robotics complete natural intelligence (i.e. Biological brain) needs to engineer artificially (i.e. Bionic or Bio-electronic) brain or Artificial Intelligence which performs function similar likes human brain by human being. Hence strong –A.I implementation only solution front of us. Strong- A.I is most suitable for Humanoid Robotics because level of intelligence creating and problem-solving skills are high , smart and self-learning programs ability is also high, thus needs less programming guidelines and Autonomy is high for examples , Neural – schema’s , Bionic brain, Neural network and genetic algorithms , Natural language processing and genetic algorithm to get in depth knowledge of it.

2.5. AI Routing Model (AIRM) (See Annexure-4 for Figure).

This model is not about to give you knowledge about how Humanoid Robotics engineering is carried out, but instead of it this model help you how to start research in Humanoid engineering, and what channels available and how to positioned yourself for concise research thus I labeled this model as “A.I Routing model (AIRM)”, this model finalized research channel in the field of Humanoid Robotics moved engineering in correct direction. To start research in Humanoid very first must have to studies Human(Natural) Intelligence, that functions and processes of Human brain and Biological Neuroscience i.e. how brain accept data ,process and control information through Neurons and Neural Network . It can be possible with the help of psychologist, Neuroscientist etc. Then after at next move is how to engineered advanced digital/optical/quantum logical electronic circuits using semiconductor technologies advanced tools like ULSI and Nano circuits etc., and finally how can engineered and assembled” Artificial Intelligence (i.e. copy of Natural Intelligence (Human Brain)) which is GOD made on silicon wafer which is MAN made, so called A.I using digital logic ICs, quantum /optical circuits and programs for them. After the successful unit testing we must have to think about how could we able to engineered “strong-A.I” with integrating and engineering all these advanced Intelligence assembled units/parts/block/programs modules etc.. This represents to brain-like processing ability through machine. When we engineered such string -AI using Neural Schema’s and Network ,we can further able to combined/cascade all strong AI human-brain like multi-functional intelligence modules to engineered “Bio-electronic(Bionic)” brain i.e. Manmade artificial brain work similar like God made Natural Human brain to fit in Humanoid.

2.6. Bionic Brain Engineering Model. (See Annexure-5 for Figure)

This is the last model I traced present and future considerations in Humanoid engineering with special preference to “Bionic Brain” hence named it “Bionic Brain Engineering Model (BBEM)”. This model is further segmented into 8 segments of Bionic Brain Engineering like ‘sensation process & control engineering’ which reach environment stimuli’s up to Bionic Brain of Humanoid i.e. how to sense and process input signal from human & environment through sensor using intelligence software supports. Second is ‘Actuation Process & control engineering’, for output human like response from Robot after sensation & processing input signal , in this engineering segment also need to well synchronized intelligence software with physical body i.e. hardware parts of Humanoid Robot like motors, joints, pneumatic units & control, storage, logical processor, buffers, servo motors and so on. Next important engineering is ' Data information processes & control engineering' i.e. how robots accept & process voice signal, text, images, smell, touch and likewise several signals as well as identify & control them during processing. Next is 'Human Intelligence mimicking 'into sub-routine, sys-calls, procedures, genetic Algorithms, Neural Network, Neural Schema's and so on. Next and very important domain of Bionic brain engineering for Humanoid is 'self-learning programs and futuristic logic for possible self-learning. Simultaneously algorithm forth engineering domain fifth domain must have to interfere with forth one i.e. 'Strong –A.I 'and Strong –A.I agents, logic designing & programming for feelings, love, emotions, expressions, desires etc. One very important engineering aspect of Humanoid is also how could Human-like central processing control hardware possible to develop look like human body and skill & movement like human body. After this next engineering approach is ultra-low power consumption management i.e. designing of small, highly dense, durable, reliable with high density of storage, memories, buffers, storage required, generally where energy sources are inbuilt and rechargeable to give mobility and autonomy to Human Robotics.

3. Conclusion

Humanoids are now being developed in Asia, the U.S., and Europe, though a clear business plan has yet to emerge. The early systems are expensive and brittle, being used as test beds to develop walking, manipulation and human-interaction capabilities. As these skills mature, and are coupled with better engineered machines, the potential is unlimited. The only questions are: when will these future humanoids become viable, and who will make the first "Model T"-equivalent system. The lack of a clear business plan will not limit interest and investment in humanoids for two reasons. First, there is an emotional and cultural drive towards building machines that look and work like humans. The Japanese eager embrace of robot technology is equaled only by the U.S. interest in the dangers of humanoids depicted in our science fiction. The Korean focus on humanoids as a part of a highly wired and ubiquitous urban landscape is a third view, with building-integrated systems gradually yielding to mobile, human-like robots that can be upgraded more quickly than a home. Many of the current prototypes are viewed as "mascots," as symbols of the future and their developer's quest to lead. Wherever humanoids go, they will evoke strong emotions and opinions, from love to hate. But the drive to build them is strong, and not motivated by economics in the near term. There is a second reason for the inevitability of humanoids. They encompass a large set of robotics domains. The archetypical humanoid, though not yet realized, will be able to loco mote through most terrain, as humans do. They will be able to perform value added work, building with hands that take inspiration from human limbs, handling objects and using tools with dexterity. They will slip into our society seamlessly, but over time as the technology matures, filling roles not well suited to humans. They will fit into our buildings, they will walk through our society, and they will manipulate the objects of modern life. Humanoids represent a massively complete system design, combining the research of cognition with navigation, perception, and manipulation. The completeness of this form yields a spectrum of functions that can not be ignored. Most researchers would be able to use a humanoid platform today for their research, if one existed that they could afford. The humanoid is where the robot began, in the imagination of the science fiction writers of the 20th century. Now it seems to be the engineers turn. The 21st century will see humanoids leave the pages of fiction and step, roll or run into our world.

Annexure-1

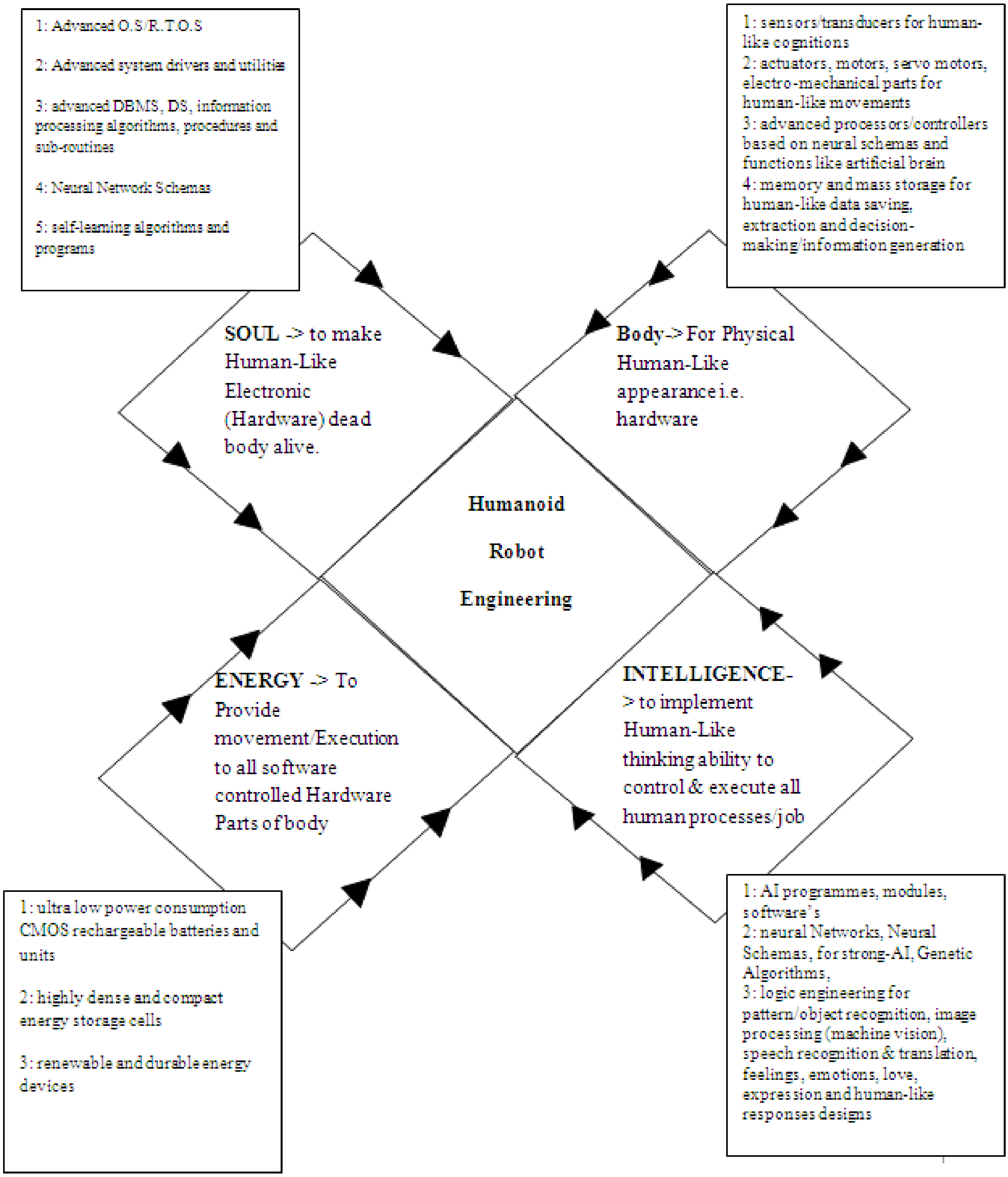


***Fig 2:** Basic Humanoid Robot Engineering Model (Source: Prof. Md. Sadique Shaikh)*

Annexure-2

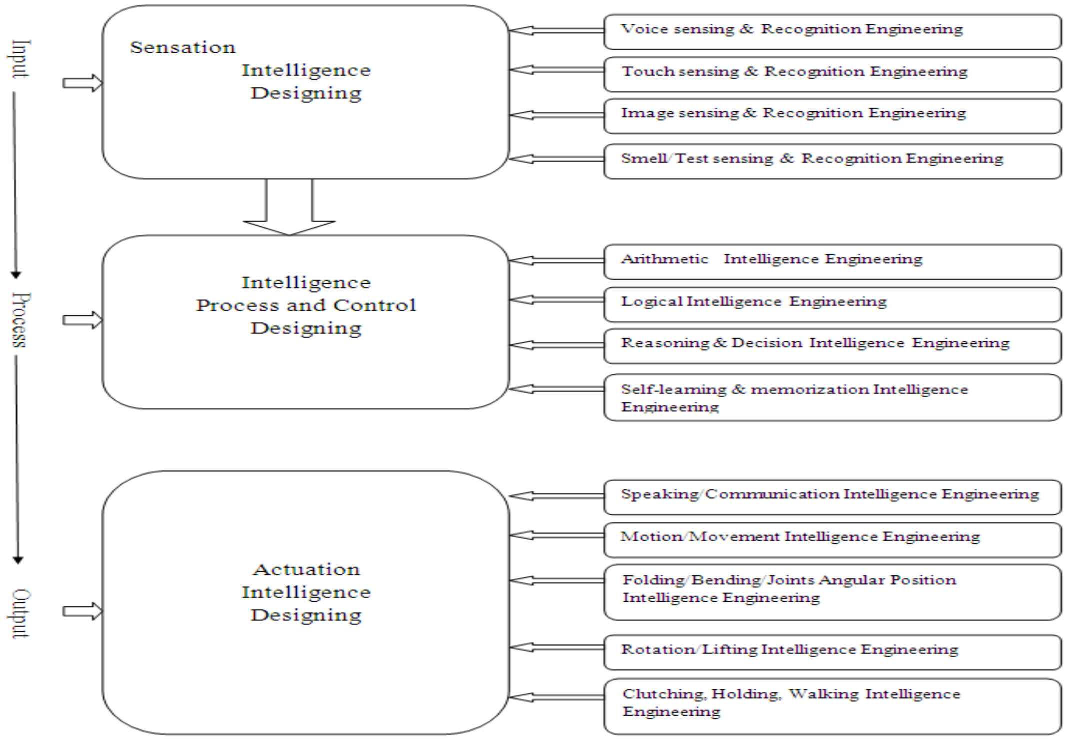


Fig 3: *Intelligence System Designing Model (ISDM)(Source: Prof. Md. Sadique Shaikh.)*

Annexure-3

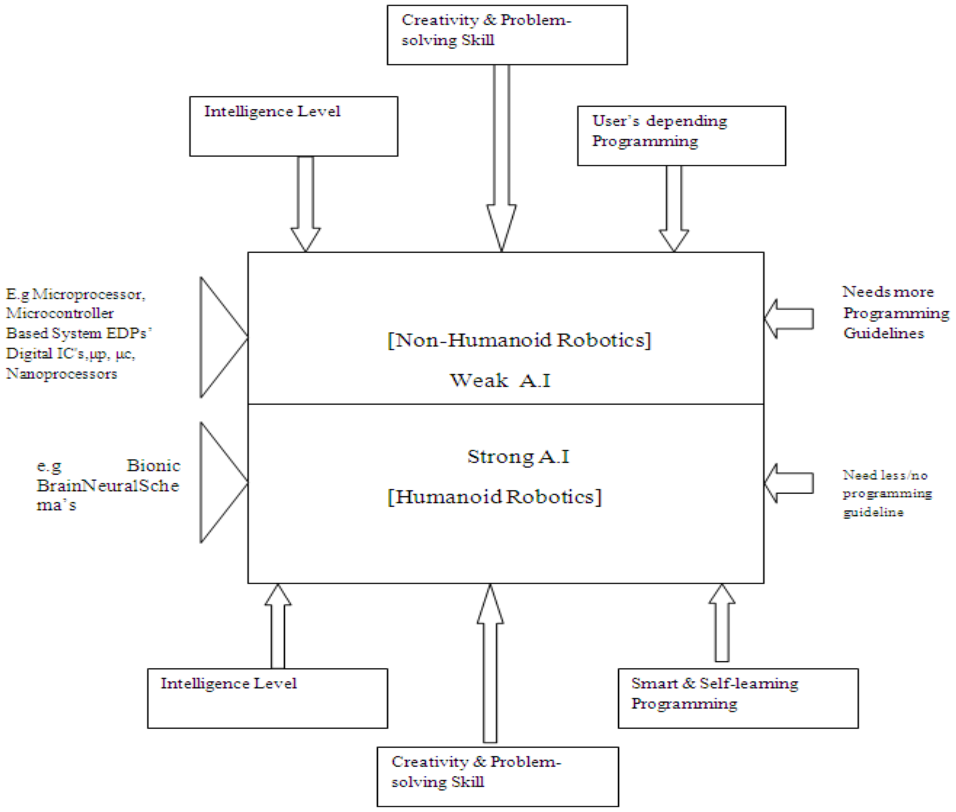


Fig 4: *Intelligence Domain Model (IDM) (Source: Prof. Md. SadiqueShaikh.)*

Annexure-4

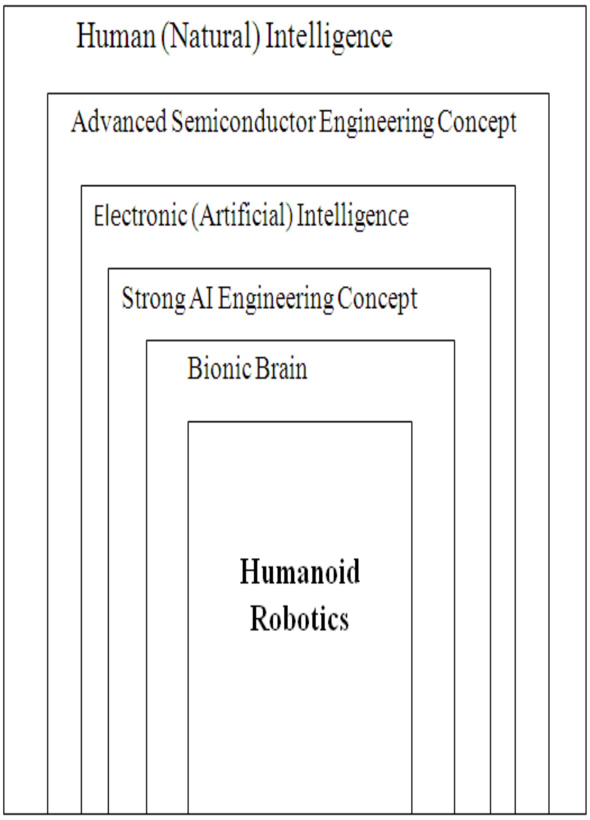


Fig-5: *AI Routing Model (AIRM) (Source: Prof. Md. SadiqueShaikh.)*

Annexure-5

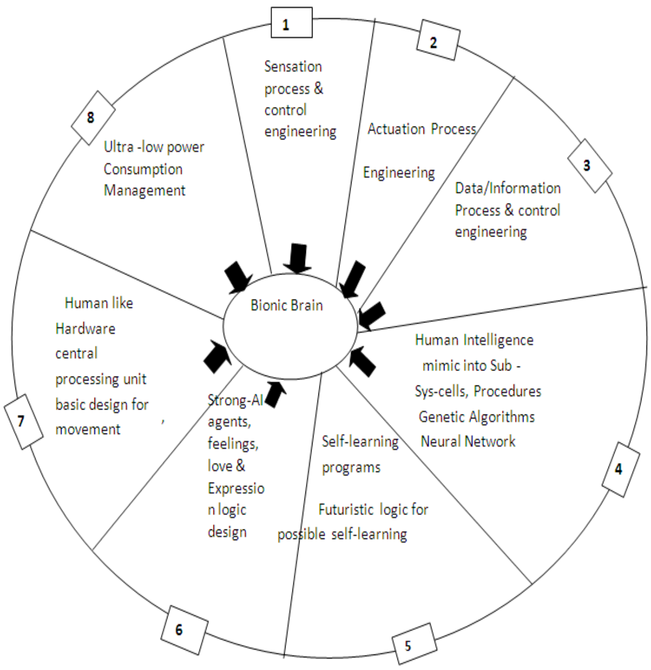


Fig 6: *Bionic Brain Engineering Model. (Source: Prof. Md. SadiqueShaikh.)*

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