The use of Robots for Sustainable Labour Force and National Development

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Abstract—**Man in his quest to meet daily life challenges within the shortest time possible whether domestic, office, industrial, public or private has led to various inventions and discoveries. Computer emerged as his most current vehicle of hope. The advents of computers led to the emergence of robots and improved automated systems. This paper attempts to review how the world of robots directly impact on human labour and the development of nations. This study hence browses through from the personal assistance robots to their industrial usage; also the technicalities in the design and operations are all discussed. Recommendations were made which if adhered, will gear the world towards becoming a better place; because of robots.**

Keywords—Robots Technolgy, Robots Applications, Artificial Intelligence, Industrial Performance, Labour Performance.

I. INTRODUCTION

Robots are part of the fifth generation computers initiative; they form a branch of technology called robotics which deals with the study of robots. This study is also called Artificial Intelligence. Robot is defined as a mechanical or virtual intelligent agent that can perform tasks automatically or with guidance, typically by remote control [5]. It further states that, in practice a robot is usually an electro-mechanical machine that is guided by computer and electronic programming. Robots can be autonomous, semi-autonomous or remotely controlled. Robots range from humanoids such as ASIMO and TOPIO to Nano robots, Swarm robots, Industrial robots, military robots, mobile robots and servicing robots. By mimicking a life-like appearance or automating movements, a robot may convey a sense that it has intent or agency of its own. Webopedia further explains it as the branch of computer science concerned with making computers behave like humans [17].

Programming robots for real-world application introduces considerable difficulties due to the complexity of the task at hand [4]. This is because robots aim at humans as the point of reference; that is doing things like humans. Today laptops, palmtops, wearable computers and the like; gadgets that help realize ubiquitous computing [12, 18], coupled with improved and reliable network connectivity, calls for not just the use of computers running software at far off ends, but for intelligent robots and also devices serving physical mobility at remote places.

Is also [18] perceived that as a niche product, robots are already being accepted as machines that could become a part of our daily routine. As the personal robot market expands, new players are emerging with innovative robots, trying to shake the hegemony that countries like the US, Korea and Japan enjoy in this segment. It is believed that the world of robots comes with the intention of shouldering human labour that is, to give man rest probably on every side. Robots have been used in industry for many years, and with the advancement of technology, the need for better-trained designers and technicians for these precision machines has grown [10].

There are more forecast and actual development in the world of robotics going on. Tiankov made a statement cited as follows:

In the Twenty First Century the robotized technologies are going to perform a very important role not only in industry, but in the human life as well. The robotized technologies develop rapidly for domestic services and entertainment purposes. A big number of scientific publications and scientific congregations and events in recent years form a new scientific area dedicated to the mutual interaction “man-robot” [8]. This is an interdisciplinary scientific field that includes robotics, cognition sciences, physiology and sociology [13].

Due to the anticipated usefulness of Robots, the educational sectors sees it a necessity to encourage robotics study in the school curriculum. It is further asserted [10] that as a result, universities have been trying to incorporate robotics education into their educational programs so as to better prepare students for the technical world they will encounter. Thus, there is a call for more students to begin learning robotics at a younger age and to start understanding the most basic concepts so as to be well prepared for the strenuous learning that will occur in a university setting.

II. THE WORKINGS OF ROBOTS

Robots are practical computers with super intelligence; they are programmed like any other computer software or applications, but with very high capacity and large sum of programs built together.

In the study of a variety of robots and devices, this paper found that for robots to be operable, most devices need to pass through a definite set of sequences. It has been worked and given an in-depth framework design and operations of robots stating the sequence required by these devices. This sequence takes the steps as follows[1]:

Device initialization: Signifies when a robot/device interfaced to the hosting machine; it is powered on, the electronic or infrared controllers are activated. These active communication paths support the communication protocol between the device and the host computer as defined by the manufacturer. The initialization of device is in phases, these are:

- Configuration loading: Robots are basically a congregation of actuators and sensors, each of which has its own operation settings. For instance, servo motors of a Robix Rascal robot can be positioned within a range corresponding to 1 to 1400 units. Similarly the robot as a whole needs to keep track of a number of sensors and motors attached to it.
- Loading history-database for intelligent operation: In advanced robots where past experience and intelligence are preserved, reloading the relevant databases becomes a pre-requisite. This operation has to be performed each time the robot/device becomes functional.

Device operation: Once the device becomes directly operable by the device driver, it is in a position to accept a command from the user and convert it into a sequence of register operations supported by the hardware controller of the robot. It can also query the controller for feedback from the robot/device and pass on the information onto the user.

Device clean-up: This is the reverse process of initialization. Before the device is powered down or disconnected it needs to update some book-keeping information, the most prominent ones being -

- Back up of configuration data
- Updating the Intelligent data store

All the programmable robot/devices come with their own device drivers and the rest of the world sends commands or requests to these drivers through the relevant Application Programming Interfaces (APIs) provided along with. Device drivers, as mentioned, are often made available in the form of a Dynamic Link Libraries (DLLs), which gets loaded into the memory and makes the concerned functions available to other applications. These libraries contain low-level functions and internal data structures to store a variety of state information about the robot. The low-level functions usually contain machine code to directly access system resources useful to the robot. During execution, the application should be able to locate the DLL so that it can load it onto the memory to enable it dynamically bind to the referred functions as elaborated further [1]. Once the application used the functionality provided by the DLL, it should be unloaded from memory.

III. DESIGN OF A ROBOT

Designing a robot takes a great deal of understanding of what the robot is supposed to accomplish and how the robot will accomplish that task. The robot must be able to quickly or accurately complete the task or even do the task quickly and accurately. In this sense robot could be describe in one word called Manipulator. Borboni and Faglia stated that the three important parameters for describing the precision performance of a robot are resolution, repeatability and accuracy [19]. These could be define briefly as follows; Resolution is considered as the smallest move a robot can make, then the ability to return to a previously achieved pose is called repeatability. Accuracy is then described as its near-performance. Wikipedia further buttress that most industrial robots in the market now have a repeatability value of .1mm or less [20]. This means that if a robot was to go to a point in space, move away and come back to the same point, it would be within .1mm of that point. This is quite an amazing accomplishment considering how fast these machines move.

On how robots are designed, this paper adopts the design work of Tiankov [13]. Also in explaining the design some key terms like ‘control systems and tools’ were used. The paper hence explained the design thus;

Actuators and computer control system. This is because the control system is appropriate to control human-oriented robots and mechatronic devices for laboratory, education, home, office and other places which blends properly with the intends of this paper presentation. The technicality of this design ranges from the type of robot one desires to build base on what it is intended to do and hardware required. To briefly discuss these technicalities Marco’s edited work itemized them base on design requirements, these are stated thus;

1. A mobile platform, whose function is to provide the basic structure that, supports the robot and the motion system.
2. A robot arm, with the mission to perform simple object manipulation task.
3. A vision system, responsible for giving the feedback to the user in order to control the robot.
4. A power supply system, responsible for providing the required electrical power to all elements of the robot.
5. A control system, which manages the communication between the different peripherals and the user.
6. A user interface, in charge of interacting with the user. [21]

For some human-oriented applications, there is a choice between using servomotors and stepping motors. Both types of

motors offer similar opportunities for precise positioning; therefore the paper discusses stepping motors.

Stepping motors can be viewed as electric motors without commutators [6]. Typically, all windings in the motor are part of the stator, and the rotor is either a permanent magnet or, in the case of variable reluctance motors, a toothed block of some magnetically soft material. All of the commutation must be handled externally by the motor controller, and typically, the motors and controllers are designed so that the motor may be held in any fixed position as well as being rotated one way or the other. Most steppers, as they are also known, can be stepped at audio frequencies, allowing them to spin quite quickly, and with an appropriate controller, they may be started and stopped "on a dime" at controlled orientations. A very important point to note is that the repeatability of positioning done with a stepping motor depends on the geometry of the motor rotor.

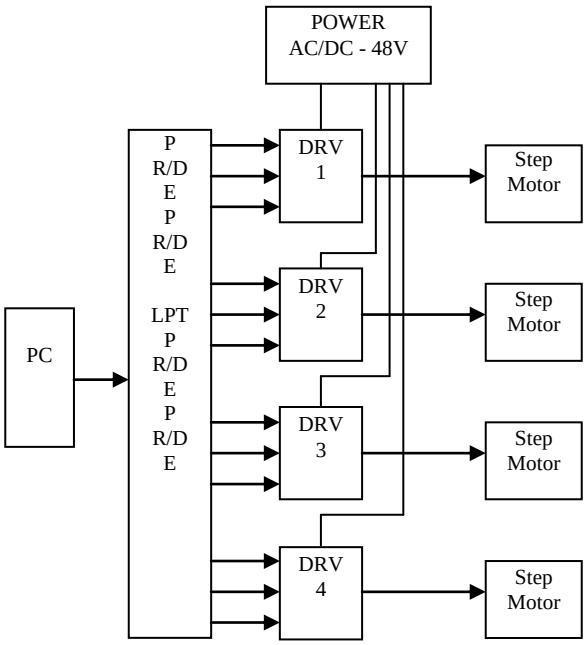
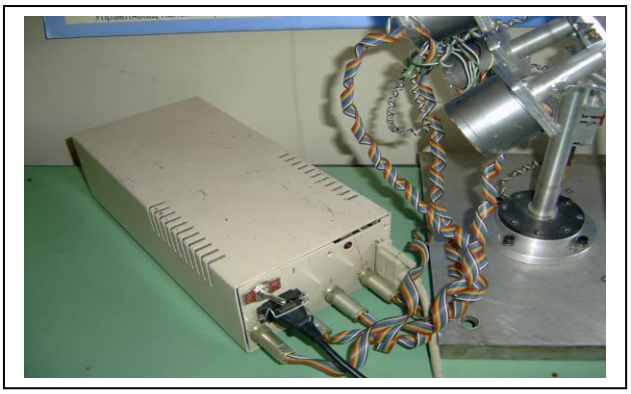


Diagram A

Stepping motors can be used in simple open-loop control systems; these are generally adequate for systems that operate at low accelerations as human oriented devices. In this work a variant of computer controlled drive system is chosen. Here the drive motors are step motors with 1.8^{o} step resolution. The control system consists of four drivers, forming the impulses with desired phase and power. The block scheme of this control system is presented on Diagram A. Via parallel port [LPT] impulse series are fed to each of the drivers time independently. The set of the 3 independent signals to each of the drivers are enabled [E], direction [R/D] and impulse series, defining the rotation speed [P]. Drivers are with 48V DC supply via AC/DC converter. The general view of the control system is drawn and shown on Diagram B [13].



(both diagrams were adopted from Tiankov work)

Like the Delta robot briefly mentioned in the later part of this work, the design of the Delta robots, which is based on parallel axis geometry, is ideal for high speed performance. By enabling fast movements and high speeds, Delta robots correspond with market demands [14].

Although not all industries can utilize robots, there are many that have been opened up due to a robot's ability to use a tool. Brown and Sammut define a tool as an object that is deliberately employed by an agent to help it achieve a goal that would otherwise be more difficult or impossible to accomplish [22]. There are industrial robots that use tools for tasks such as welding, cutting, and painting, but these operations are carefully scripted by a human programmer. Most tools are designed by a company to suit the specific need of that company therefore; this requires an engineer that is well studied in many aspects. The designer must understand how the robot can move and how it is controlled hence determining the size and features that the designers can use in their designs.

The work shows how control system is especially important so that the designer can teach the system how to use the new tool. Most control systems allow for the user to fabricate their own tools and give a guide as to how you would get the robot to recognize it. This is probably the most complicated aspect of designing the tool because it determines how the circuit needs to be made and what valves would be used if the tool requires air or vacuum input. The wide variety of tools available for robots allows them to do many different jobs depending on what kind of programming is available.

IV. INDUSTRIAL APPLICATION OF ROBOTS FOR SUSTAINABLE LABOUR

Study reveals that in the twenty first century the robotized technologies are going to perform a very important role not only in industry but in the human life as well [23]. To understand the importance of robotics, we need to understand robotics role in the industry. This role will help determine the importance and needs for robotic education. Research into the industrial robotics market provided us with a clear understanding of what skills the market requires for employees to be successful. There are many possible robotics applications; the job market is dominated by five categories: The

semiconductor industry, automobile production, medical industry, general part manufacturing, and palletizing [10]. Utilization of robots in each of these industries' specific work environments creates greater efficiencies. Whether the job requires speed or precision, robots can quickly and accurately repeat the necessary task without fatigue. Is [10] further explained that different types of robots are used in various applications; stating that, determining the one that best suits a job description is important for optimal performance.

For instance, the semiconductor industry uses robots to make computer chips and components, the production of which requires very precise movements and procedures to ensure all the connections within the component are not faulty. There are many different robots that can perform this job, but they all have many similarities. Most of the robots that are used to make semiconductors are multi-jointed and have more than two degrees of freedom. This means that the robots are able to reach the same point in space from multiple angles, which gives the robots more flexibility and versatility within the area that they work. Unfortunately this also makes the control systems and programming languages for these robots much more complicated. Accomplished computer programmers must write motion code for these robots based solely on the aspect of path tracking. In addition, semiconductor robots work in designated cells that maintain a certain level of sterilization.

These areas are called clean rooms because the ratio of pollution particles to clean air particles is controlled. Robots working in clean rooms are advantageous because they do not emit pollutants like a human operator does. However, working within a designated cell confines the space in which the robot must move, so the programmer must take into consideration where the surrounding equipment lies.

Another very large application of robots is the automotive industry. Robots are utilized in many areas from actual car production to fabrication of specific parts. The automotive industry also requires multiple degrees of freedom in their robots as well as a heavy payload arm. Because of the weight of a car, the robot needs to use strong motors as well as strong materials and construction that resist the stress of moving such heavy objects. Kuka robotics is a German company that produces heavy payload robotic arms that can lift up to 1000 kg [9]. The BMW manufacturing plant in South Carolina has used these robots to weld the frames of some of their car models. This clearly depict how robot replaces work which nearly hundreds of people may possible not be able to do.

Automotive robots are not strictly restricted to the heavy lifting of car frames but can be applied to many other areas of the construction of a new car. These areas include the painting process of cars. This aspect presents a new challenge to the programmers because it requires the robot to apply paint to every surface of something that it cannot see. In addition, robots are also used to create many of the safety features that are used in cars. The most technically advanced of these is the creation of the air bag system. An airbag is deployed in the event of a car crash through the steering console and in most vehicles, the sides of the car. Some of these systems require the use of robotic laser systems. The robotic arm is equipped with a laser at the end and has a specific pattern that it follows to cut out the desired pattern into the part [11].

Another area where robots assists human labour is the popular use of robots to place finished parts in an order to be shipped. This is not a difficult job but greatly increases the amount of product you can move without having too many workers. A robot will not complain about the work that it is given or the weight of the product being moved. This cuts down on the production cost of a product in the long run even though a robot can be a costly investment. Robots in this line of work can be very simple, only moving in one motion, or they can be more complex depending on how the product is being moved. Heavy payload robots can be used to move 50lb bags of product effortlessly and constantly where low payload robots can move a single pen in to a box very quickly. The simplicity of these robots makes them very good tools for the job. This clearly concur that robots stand to play a very vital role in sustaining difficult labor activities in the society. A typical example of such is the "Automated Biscuit Handling with a Gentle Touch" [14]. The robot is called "Delta Robotics" from Bosch; it greatly improves Efficiency and Reduces Waste. In experimenting Delta Robot For instance, the OEE (Overall Equipment Effectiveness) parameter for the entire line was agreed on and achieved with the new solution, and it resulted in a 5% improvement in efficiency compared to the previous manual feeding system. In terms of speed, Bosch's new robotic solution was able to deliver an output of up to 140 bags per minute. McBurnie, a Bosch staff stated: "We are very satisfied with the packaging line speed" [14].

In the medical industry, robots are widely used as well. This industry requires a very strict type of clean room due to government regulations on medications. Robots in this industry are used for jobs that require the product to be protected from as much contamination as possible. Thus, in this industry, robots are not built to lift heavy objects but rather they are designed to not emit pollutants or have any surfaces that would collect pollution. The operator in this case is used to clean the work area thoroughly before and after every process. It is also crucial that the operator watches the process so as to be sure that no mistakes are made or accidental contaminants get into the product. The programming is also very important as to getting the correct timing down for each step of the process. This is because the medicines and vaccines that we use in everyday life are so common that any mistake could affect lots of people.

The precision and speed of a robot makes surgery an enticing possibility for the application of these tools and by having a robot conduct surgery, the cleanliness of the operating table greatly increases. Hence human labour is greatly assisted.

V. ROBOTS FOR NATIONAL DEVELOPMENT

Robots technology has very good intention embedded in it. The advantages they carry are not just to assist individual but have national advantages. Nations stand to benefit immensely in almost all the sectors of government (education, economic, agriculture, manufacturing, etc). Is also asserted [2] that

interest in mathematics, science and technology based courses at both pre-university and tertiary levels have been steadily declining over the past number of years. To overcome this problem, is further stated that different strategies have been employed to regain popularity in these areas of studies and many schemes have been undertaken to implement these strategies. One of more successful and promising strategies attempted by Central Queensland University (CQU) is the utilization of robotics as an educational tool. Here robots assist in teaching and undertaking difficult concepts in education especially concepts which requires a lot of repetition for easy grasping, and areas which are humanly dangerous to handle in teaching; like some laboratory experiments and field exercises (studying the milky galaxy, visits to sun etc) where special simulations are adapted using robots. Educational development is of great importance to the development of any nation, there is a say that "no nation can out-grow its educational level" meaning that the level of growth of any nation is greatly determined by her level of education.

Distance, time and space has affected national culture sustenance, for instance, people are forced into adapting culture of food, dressing etc of other nations once they are away from their countries. For example Xinyu made a comment "Most Chinese Dishes you taste in your country are far from original Chinese cuisine!" [17]. He concluded by saying "How nice if we could have a machine that will cook the original, safe and delicious food for us". All these lies within the world of robots since robots will not copy but give the originality from its program, meaning that a robot meant to prepare a certain dish is capable of maintaining the standard accurately regardless were it is used or kept. So in robots, boundaries of culture do not exist.

Robots in general settings can be found making almost everything. Besides the speed and precision of a robot, a company using robots would increase production through the long operating hours of the machines. Robots in industries and manufacturing companies bring about low labor input and high output. Today countries manufacture goods capable of meeting the needs of the world populations. These yield much income for the nation. Vision 20:2020 refers to industrialization, and industrialization simply means desire to become one of the world economies [7]. Surely this cannot be achieved by human bare hands; rather it is talking of human-assisted devices which mean robots. Robots will surely increase nation's agricultural growth, mineral explosion, car manufacturing, textiles factories efficiencies etc hence improving the nation's Gross Domestic Product (GDP). This is because high output as a result of robots will lead to high income and revenue generating means for the government.

Fears have been allaying that Robots will not take the labour off our shoulders alone but will take away our jobs. This fear has been laid to rest as Robots only take off the labour of our daily routine activities and replaces them with more intelligent opportunities of thinking deeper and bringing up potentials which are buried as a result of repetitive routine activities. Man can now think on improving his life and even better the world of robots since the robot is the child of his knowledge and he moderates the depth of his robots operations. This will further create and breed more intelligent school children who will be adventurers in national development.

VI. CONCLUSION

Many different areas of application of robotics are being exposed all the time and it is only a matter of time before robots find their way into everyday life. A few of the more popular possibilities are robotics surgery and robotic consumer products.

Consumer products are always becoming more robotic as products are able to do many more functions without user input. The ability for these machines to gather information and interact with their environment makes them very capable of making their way into the consumer product market. The advancement of vision systems into more robotics applications will help to make robots more capable of being incorporated into more industrial applications.

Conclusively, it is now a fact that any nation stands the chance of growing its GDP, improving its efficiency of production to the yielding of fast growth in its socio- economy and socio-political system if robotics technology is given the opportunity.

VII. RECOMMENDATIONS

The study from both the industrial robotics review and the other reviews suggest that robotics is moving more and more towards the industrial setting. Upon study, the research has it that 90% of all robotics was already classified as industrial with manufacturing grabbing the most of the market [10]. This suggests that robotics engineers need to be trained for the industrial robotics application and that well-rounded robotics knowledge will best prepare these engineers for future careers.

Citing from the design, it shows that building of robots is an expensive exercise though very rewarding in the end, the writer recommends that financial organizations should aid robotics engineers. Especially in developing them and in provision of raw materials (electronic equipment), this recommendation rightly applies to the third world countries in which very little budget goes for science and technology development.

Lastly, the development and improvement in robotics technology should not rest only on the shoulders of mega organizations, companies or factories using them, but more stakeholders like educators (school executives and proprietors), government and government agencies, non-profit and non-governmental organizations should develop interest and provide support in the advancement of robotics. Even though the world of robotics may affect them only partly; but sooner or later the usage will cut across.

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