Introduction

For the last two decades, the application of robotics is diversified in the industrial sector [1]. In majorities of the automation sectors especially car manufacturing and food industry, the industrial robot has replaced the manual labour. This type of implementation does not only reduce the labour cost and time but also produce the output with proper accuracy and quality measures [2]. Besides that, most of the packaging sectors are being automated with an intelligent system. The cost of robotics-based technology is decreasing day by day while the cost of manual labour is increasing. In the USA, manufacturing jobs has constantly paid considerably more than the minimum pay scale. Even today, the workers of manufacturing industry can earn about $20.17 per hour which is about three times the government’s lowest pay permitted by law [3].

To compete in the market with cheap inexpensive products, most of the industries are replacing their manual labour group with automation. Besides, the tax policy is neglected because most of the tax of a state normally comes from the people of lower income group [4]. That’s why most of the industries are trying to fill those gaps with automation just to avoid the tax from the government.

Global news said that almost 5 million jobs have been disappeared [3] due to the advancement in technology in the manufacturing sector. Statistics show that total no of workers employed in US manufacturing sector is degreasing for the last 40 years as shown in Figure 1. With the invention of new technology [5] like artificial intelligence, genetic algorithm and machine learning, new job sector is created but the problem is about the level of the jobs. The jobs created due to the advancement of technology are for a high-skilled worker who has enough knowledge to fill the gap. But those people, who have lost the job due to the application of robotics technology, are labour class people who are merely having the education to fit into the current technology. There is no compensation package for those people. It is not possible to stop the use of technology because it will degrade the quality of life. On the other hand, it is difficult to upgrade those jobless people to meet the requirement of new technology. In the growing economy and population, it is difficult to make each and every person qualified enough to fit into current job scenario. Most of the solutions focus on different regularities for workers such as labour act or minimum pay range under the National Minimum Wage Act [6]. Few policymakers are thinking about putting a tax on the robotic system [4]. However, there is one solution which can solve both the situations by maintaining the use of automation in the manufacturing sector and sort out the job crisis to a certain extent. We should focus on those robotics technologies which can enhance the human power regardless of supplanting them so that a normal human can act like a robot and the performance coming out from them is equivalent to a robotic system.

Abstract

To accelerate the economic development and meet the requirement of growing population in the world, human labour is being replaced by the robotic systems in the manufacturing sector. Due to this, a large number of unskilled workers have already lost their jobs. Indeed some jobs have been created to produce those robotic systems and for their programming but all those hi-tech jobs are only limited to the skilled workers. Therefore, one solution can satisfy both the situations by keeping the application of robotic systems in the manufacturing sector to improve the productivity as well as the jobs of those unskilled workers, which is the creation of different robotics technology that enhances human power in spite of replacing them. In this paper, we have talked about one of the robotic power enhancing gadget known as exoskeleton. Exoskeleton is an external body attached muscle suit which does not only help the humans to produce more power like a machine but also improve their performance. It is shown in the paper that the portable exoskeleton is getting superior in the market compared to the stationary one because of its ability to support the human in a dynamic condition. Also, the desired key properties of a portable exoskeleton are discussed to make it comfortable and affordable for the society.

Keywords: Employment; Robot; Exoskeleton; Portability

Figure 1: Manufacturing jobs in U.S. [5].
Methods

In order to handle the situation, the production of different robotic technology which amplifies the human strength, is boosting at the present time. Out of those several solutions, the exoskeleton is emerging as the best outcome. Exoskeletons are designed to be worn for training and assistance. These robotic systems are designed based on the function and shape of the human body and the user is able to control the robotic limbs. Exoskeletons can assist a human in different activities which one would normally not able to do. As an example, different robotic muscle suit is now used by the military personnel in a war zone for undertaking strenuous works such as lifting under hazardous loading conditions. It can be fit to different parts of the body such as an upper limb, lower limb, wrist and the full body. There have been various researches are going on human arm exoskeleton. It began with the idea of supporting the military. However, as the time proceeded onward, the region of utilization has been extended to a substantial number of assorted applications. Extensively, the use of exoskeleton can be divided into three major applications. First of all, it can be utilized as an assistive device for the paralysed and elderly people, furthermore, as a helpful gadget for patients experiencing distinctive neuromuscular shortening. Lastly, the automated exoskeletons can be utilized as a capable muscle bolster for the military workforce in rough conditions. The design and development of such systems are driven by the various prerequisites relying on the application. After analysing the working principle of the exoskeleton, it can also be used for the people working in manufacturing industries to improve their performance. There are two types of exoskeletons; one is stationary and other is portable (Figure 2). The stationary exoskeleton is attached to a stable ground-based system. It can be used by the workers working on a static platform such as conveyor belt-based assembly line where the path of manufacturing is predefined and unchangeable. However, the exoskeleton needs to be portable to support any person in an industrial activity where they have to move from one place to another. Present market research shows that the market of the robotic exoskeleton is exponentially increasing in the future Figure 3 and the number of exoskeleton sales will reach to 120000 units per year by 2025 [7,8]. Also, the demand for the portable exoskeleton will be higher than the stationary one [9]. The stationary system can only be used in a static platform where the user does not require moving from one place to another whereas the portable system can be used for both environments; static and dynamic.

Although a large number of exoskeletons have already been developed and a lot of researches have been undertaken on it, there are some major issues which restrict their usage as a portable device. There are a few significant factors which should be incorporated in the actuation system to get a compact and lightweight exoskeleton. All these key features have been categorized into four divisions as shown in Fig. 4: functional activities, technological characteristics, financial benefits and psychological benefits. Out of the four divisions, the first two are highly important. Functional activity is related to the appropriate functioning of the system which does not only include all kinds of operations but also ensures safety and comfortability to the users. The main requirement of the exoskeleton is to make it a handy device which can be easily put-on and taken-off. There has been no standardization of designs on portable exoskeleton structure. However, there are some design specifications which can be considered to make a portable device. The key factor is the torque to weight proportion which ought to be sufficiently high to complete most extreme load amid operations. In the same time, the heaviness of the framework ought to be low with the goal that it will be wearable and advantageous to move. There are several actuation mechanisms that have been designed for exchanging the movement from actuator to human joint. Choice of actuators and their supporting mechanical structure are the central factor of the required joint torque required to move any joint. The structural material is also essential for maintaining the weight. The degree of freedom is another vital component of the system as the system is connected to the human joint. A joint like elbow has only one degree of freedom whereas the shoulder and wrist joint possess multiple degrees of freedom: a minimum of three and two respectively. If the exoskeleton is based on the full

Citation: Manna SK (2018) Robot or Robotic Assistance?. MOJ App Bio Biomech 2(1): 00037. DOI: 10.15406/mojabb.2018.02.00037
human body, the structure should provide all degrees of freedom a human body has. Besides, the battery life is likewise essential for providing power to the exoskeleton for a long time. It is important to make the exoskeleton a cost-effective product compared to the manual labour. The control architecture makes those systems user-friendly with the environment. Usually, those robotic exoskeleton systems are manual or automatic. Some systems are semi-automatic (manual with some automatic features based on the user’s requirements). In the current scenario, different adaptive control schemes [10] are implemented in different exoskeleton systems where the functions and parameters will be modified accordingly to the user’s requirement and environment. Sometimes the complicated architecture and mechanical look could be an issue for its usage. Even though appearance is the slightest imperative among all the development parameters of the exoskeleton, it should at least give a wonderful and stylish hope to make it appealing to the client.

**Conclusion**

Based the statistics and market survey, it can be concluded that the portable exoskeleton can be one of the solutions to maintain a stable growth of manufacturing sector without hampering its productivity in the growing population. Researchers have already developed a few commercial exoskeletons; however, most of these designs did not go beyond the laboratory environment and were mainly used either as a research tool or as experimental devices. It is therefore required to implement the desired features into a single system to make it portable and handy.

**Acknowledgment**

None.

**Conflict of Interest**

None.

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