ACTA MECHATRONICA

2022 Volume 7 Issue 4

International Scientific Journal about Mechatronics

electronic journal
ISSN 2453-7306

CONTENTS

(DECEMBER 2022)

doi:10.22306/am.v7i4.87

Received: 23 Nov. 2022
Revised: 03 Dec. 2022
Accepted: 19 Dec. 2022

Testing LAD1 of harvesting electric roads

Mohammed Alaa Alwafaie
István Sályi Doctoral School of Mechanical Engineering Sciences, University of Miskolc, Hungary, EU,
Starala45@gmail.com (corresponding author)
Bela Kovacs
István Sályi Doctoral School of Mechanical Engineering Sciences, University of Miskolc, Hungary, EU,
matmn@uni-miskolc.hu

Keywords: piezoelectric effect, energy harvesting, testing PZT.
Abstract: Alternative power sources for roadway accessories have been brought to light through energy harvesting technologies. Several types of nanogenerators can harvest energy from rotating automobile tires by using the piezoelectric effect to generate electricity from these roads. As the wheel is pressed against the piezoceramic disks, energy is harvested by embedding them within a protective package. In this paper, we demonstrate the testing of several types of electric vehicles and how they are tested for electric performance and determine the output voltage and current.

1 Introduction

A growing interest among researchers has been generated by energy harvesting technology. Various types of energy harvesters can convert ambient energy to electricity, including thermoelectric, electromagnetic, photovoltaic, and piezoelectric [1-5]. The most productive method is piezoelectric energy harvesting, especially on roads under wheel cars. It is coming in second after photovoltaic [6-9]. We have before sits of designing piezoelectric as follows:

- Type, Design characteristics,
- LAD1 (Figure 1), It contains up to six piezoceramic disks.

Figure 1 LAD1 (layout of the assembly design) of HER

2 Testing LAD1 designing of piezoelectric

Before starting to explain the testing, we need to test the disk piezoelectric which is protected by Teflon.


Figure 2 The types of disks piezoelectric

1- tests the stack of piezoceramic-disk:

We prepared three specimens as single-layer stacks, double-layer stacks, and four-layer stacks, and these specimens were made by Zibo Yuhai Electronic Ceramic Co., Ltd. figure 2. Show the three types of discs of piezoelectric PZT-51.

An illustration of the setup of the testing frame can be found below. To determine the force applied to the paradigm, a load resistance is attached to it and a force meter is placed above it there.

The paradigm is set upon an electric shaker supported by a steel stabilizer. Lab Master software connects one computer to the meters and collects testing data. Different loading resistances are applied to each specimen to obtain voltage output data. Based on the output voltage, the following formula can be used to calculate the power/force ratio, and also depending on 1.21V of voltage can give approximately 91 N of stress. so, we write (1):

$$\frac{P}{F} = \frac{\int V^2}{R \cdot \int F} \quad (1)$$

P/F: it is the Power/force ratio.
V: it is the output voltage.
R: it is loading resistance.

A piezoceramic disk with a parallel connection generates a different loading resistance when at maximum power output. The single-piece generator should have the highest R of the double generators, while the four-piece generator should have the lowest R. Also, in general, generators should have the lowest power-to-force ratio possible, while four pieces of piezoelectric generators should have the highest.

As shown in figure 3, the plots of (P/F) versus Loading Resistance are shown.

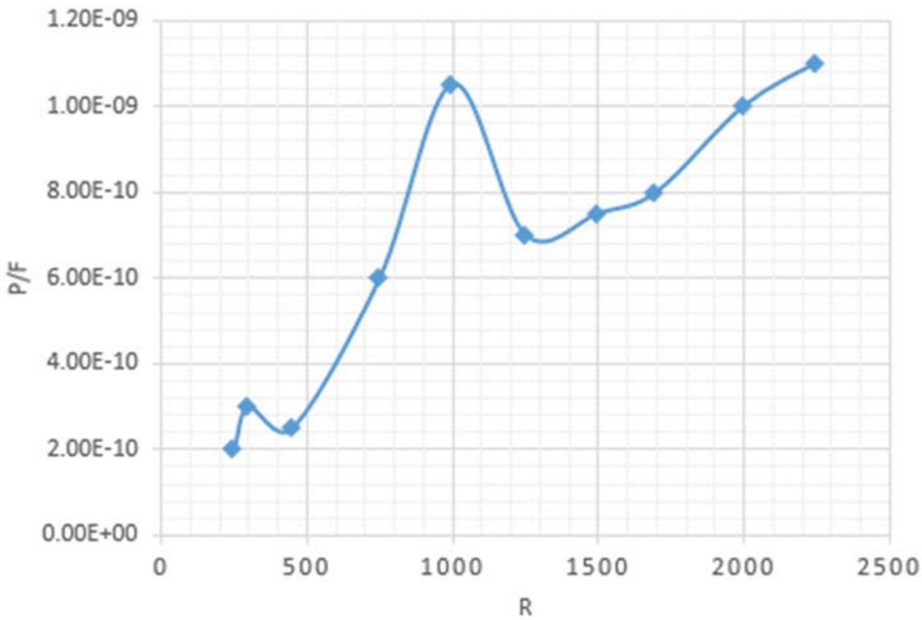


Figure 3 the graph of the single-layer generator between P/f & R

We found here that when R equals about 2250 kΩ the p/f will be more than about 1.14 $x10^{-9}$watts/N, now we need to check with a double layer as figure 4.

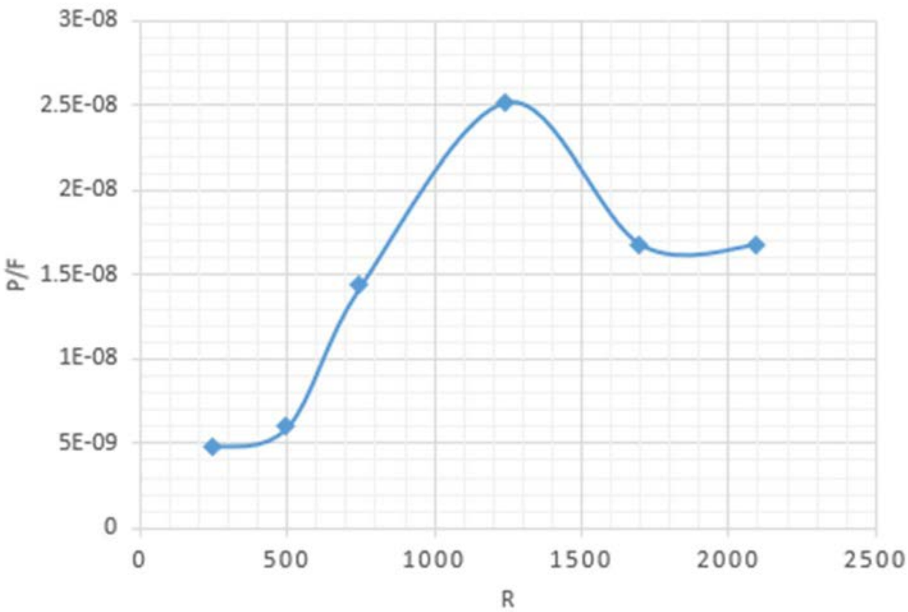


Figure 4 the graph of the double-layer generator between P/f & R

Our results here show that for R around 1360 kΩ the p/f will be more and equal to about 2.51x10^{-8} watts/N. According to figure 5. Referring to R as 1120 kΩ the power/force is equal to about 1.01x10^{-7} watts/N.

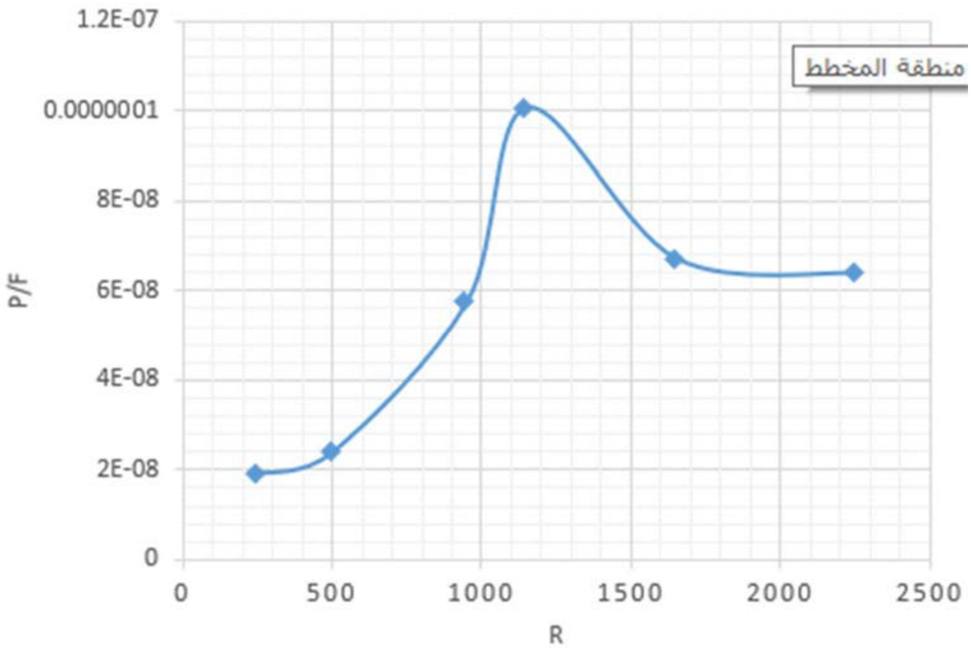


Figure 5 the graph of the four-layer generator between P/f & R

Double and four layers from all schemes for every single layer show that the four-piece generators will provide the best performance.

<u>2- tests of LAD1 harvester:</u>

It is tested by a model mobile loading simulator from the company PAVETESTING; it consists of a small wheel rotating on the top of the piezoelectric layer as shown in figure 6. A wheel's speed can range from (0 – 15) km/h and for frequency between (0 to 48Hz). Under real traffic conditions, this simulates very closely the loading conditions on real pavements.

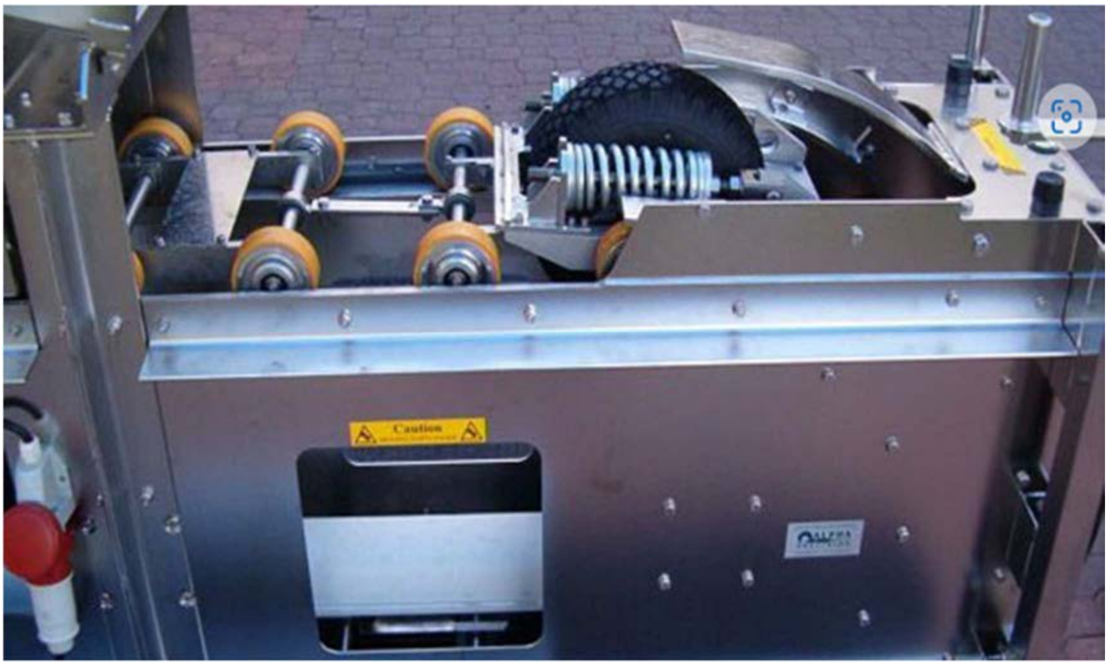
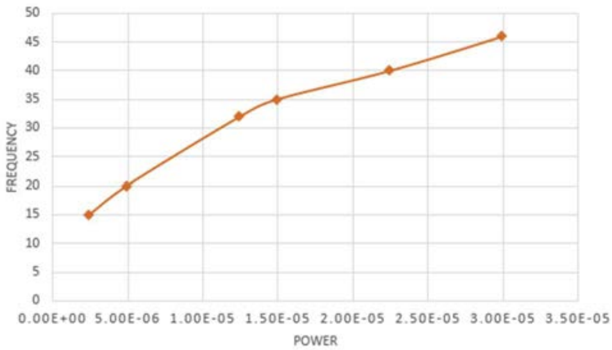


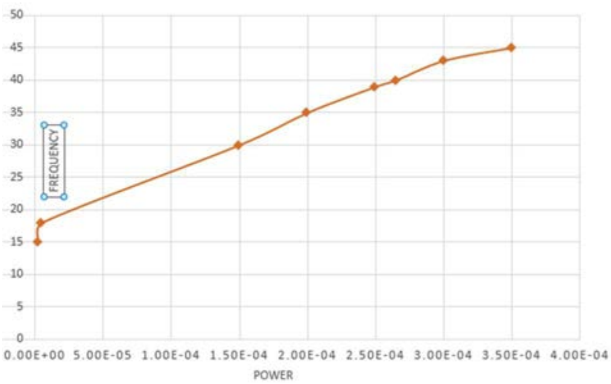
Figure 6 Model Mobile Loading Simulator

The LAD1 harvester was tested at different wheel speeds and with different resistors (335 kΩ, 565 kΩ). With an increase in electrical resistance and a speed increase in testing, power output is increased. In the region where equivalent resistance of the harvester and load equals, maximum power output should occur.

For 335 kΩ we found:



For 565 kΩ we found:



3 Conclusions

We demonstrate in our previous demo how to test for electric performance and voltage output. We have fabricated and tested many piezoelectric energy harvesters according to the proposed design, and all previous calculations indicate that the power will be greater with higher voltage.

Reference

[1] ASHEBO, BEYENE, D., TAN, CH.A., WANG, J., LI., G.: *Feasibility of energy harvesting for powering wireless sensors in transportation infrastructure applications*, In: Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security, SPIE, Vol. 6934, pp. 265-272, 2008.
[2] KIM, H., JANG, E., KIM, D., HWANG, L., YOO, J.: Thickness–Vibration-Mode Multilayer Piezoelectric Transformer for DC-DC Converter Application, *Integrated Ferroelectrics*, Vol. 107, No. 1, pp. 12-23, 2009.
[3] HAOCHENG, X.: *Piezoelectric Energy Harvesting for Public Roadways*, Doctoral dissertation, Virginia Polytechnic Institute, and State University, 2014.
[4] XIONG, H.: *Piezoelectric energy harvesting for public roadways*, Blacksburg, 2014.
[5] WANG, J., XIAO, F., ZHAO, H.: Thermoelectric, piezoelectric, and photovoltaic harvesting technologies for pavement engineering, *Renewable and Sustainable Energy Reviews*, Vol. 151, No. November, pp. 1-19, 2021.
[6] ALWAFAIE, M.A., KOVÁCS, B.: Harvester wheel energy (type 4), *World Journal of Advanced Research*

and Reviews, Vol. 13, No. 2, pp. 304-308, 2022. https://doi.org/10.30574/wjarr.2022.13.2.0147

[7] BADEL, A., BENAYAD, A., LEFEUVRE, E., LEBRUN, L., RICHARD, C., GUYOMAR, D.: Single crystals and nonlinear process for outstanding vibration-powered electrical generators, *IEEE transactions on ultrasonics, ferroelectrics, and frequency control*, Vol. 53, No. 4, pp. 673-84, 2006.

[8] HAOCHENG, X.: *Piezoelectric energy harvesting for public roadways*, Blacksburg, 2014.

[9] ALPER, E.: *Electromechanical modeling of piezoelectric energy harvesters*, Doctoral dissertation, Virginia Tech, 2009.

Review process
Single-blind peer review process.

Acta Mechatronica - International Scientific Journal about Mechatronics
Volume: 7 2022 Issue: 4 Pages: 31-36 ISSN 2453-7306

doi:10.22306/am.v7i4.91

Received: 24 Nov. 2022
Revised: 10 Dec. 2022
Accepted: 23 Dec. 2022

Industrial robotics as an important part of modern production automation

Miroslav Malaga
Faculty of Mechanical Engineering, Department of Industrial Engineering and Management,
Univerzitní 22, 301 00 Pilsen, Czech Republic, EU, malaga@kpv.zcu.cz (corresponding author)
Tomas Broum
Faculty of Mechanical Engineering, Department of Industrial Engineering and Management,
Univerzitní 22, 301 00 Pilsen, Czech Republic, EU, broum@kpv.zcu.cz
Michal Simon
Faculty of Mechanical Engineering, Department of Industrial Engineering and Management,
Univerzitní 22, 301 00 Pilsen, Czech Republic, EU, simon@kpv.zcu.cz
Michael Fronek
Faculty of Mechanical Engineering, Department of Industrial Engineering and Management,
Univerzitní 22, 301 00 Pilsen, Czech Republic, EU, fronek@kpv.zcu.cz

Keywords: industrial robotics, manufacturing automation, robot, robotics, Industry 4.0.
Abstract: This paper focuses on industrial robotics, highlighting it as an important part of modern manufacturing automation. First, the paper focuses on manufacturing automation more generally, highlighting its importance, pros and cons. This is followed by a description of fixed, programmable and flexible automation, with a link to industrial robotization. Then, the connection of robotization with other types of automation, i.e., forced and economically justified automation, is highlighted, followed by large and small automation.

1 Introduction

Today, there is a growing interest in the use of automated production equipment, mainly due to the ever-increasing pressure to improve productivity and production quality. Another reason is, for example, to increase the competitiveness of companies and keep them in the financial market. Thanks to automation, changes are taking place in production, technological and overall logistics processes, not only in engineering but also in other sectors. Manipulators and robots in particular are increasingly gaining ground in the automation of both entire processes and individual tasks in processes in various sectors. Increasing the efficiency, quality and productivity of work cannot be achieved without modernisation, reconstruction and automation of production facilities.

2 Automated production and assembly process

If we think about futuristic manufacturing facilities and processes, automation in a science fiction setting where humans are absent and production lines are controlled from the other side of the Earth may come to mind. In such systems, all parts are fully autonomous, they perform tasks with incredible precision, they don't need to sleep, they don't need refreshments, they don't waste, in short, they are the ideal workers that every manufacturer wants. As the pace of technology growth rapidly takes us into the real future, manufacturers must pause to examine the purpose of automation and how best to steer its direction. Across all industries, technology is evolving at an ever-increasing rate, and increasingly sophisticated solutions to problems are needed. The speed of progress can be described by a simple comparison. At the beginning of the third millennium, people could not have imagined the range of programs and services such as video conferencing, cloud storage, virtual reality or, last but not least, smartphone apps. In the manufacturing process, few would have imagined a complete production system ranging from autonomous stacking systems to fully automatic machining centres and robotic assembly lines to dispatch that makes do with a single code and the manufactured goods find their end user flawlessly. The steep increase in automation can be described by the worldwide number of industrial robots, which are one of the cornerstones of the automation process. Figure 1 shows the beginning of an exponential year-on-year trend in the number of industrial robots shipped, which fully describes the direction in which the industry is heading today [1].

Volume: 7 2022 Issue: 4 Pages: 31-36 ISSN 2453-7306

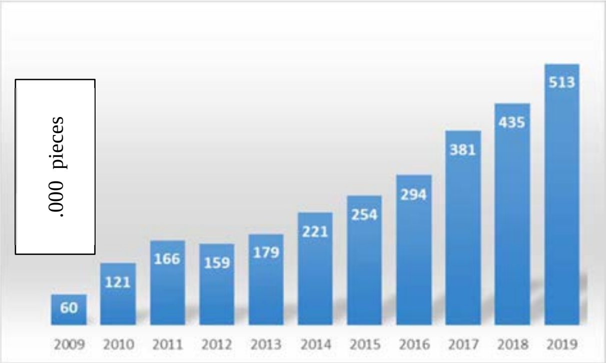


Figure 1 Number of industrial robots implemented worldwide year-on-year [2]

3 Automated systems

Automated systems increase production efficiency in factories and reduce the time-consuming nature of manufacturing operations. At the same time, these systems improve working conditions and increase safety. They also form an indispensable unit in quality control. Employees would have to expend many times more effort to achieve in a shift what they can now achieve with automated industrial systems. Production would be much more difficult and dangerous overall [3].


Figure 2 Automated assembly process [1]

Automated production systems have now become the norm for mass producers. Maximum performance and efficiency have become the gold standard for suppliers, and anything less will result in lost deadlines and lost profits due to slow, inefficient production. The goal of automated industrial systems is to maintain peak profitability in a closed manufacturing plant. It is now also essential to properly implement automated manufacturing systems in order to increase production and reduce costs. Industrial technology is far beyond the use of "one size fits all" systems. It is important that custom solutions are implemented to maximize profit [3].

3.1 Pros and cons of automated systems

The benefits of automated manufacturing systems are substantial once implemented, but it is questionable whether they are worth the large initial investment. The following section describes the advantages and disadvantages of implementing industrial process automation [4].

Advantages:

- Security,
- Increased productivity,
- Improved product quality,
- Higher yields,
- More accurate data collection.

Disadvantages:

- Cost of initial investment,
- Replacement of spare parts,
- Need for service.

Not only do automated industrial systems increase production capacity, but the quality of that production is improved, along with greater safety for plant operators. These systems can also be configured to provide more accurate data to optimize bottlenecks and significantly reduce product defects due to human error [5].

The biggest disadvantage for implementing automated manufacturing systems is the initial cost. This includes the cost of machinery and implementation of automated programming, as well as training employees on how to operate these new systems. However, the payback on these investments is around a few years [5].

4 Types of automation systems

The types of automation systems can be divided into the following three categories:

- Fixed automation,
- Programmable automation,
- Flexible automation [6].

4.1 Fixed automation

It is a system in which the sequence of operations is determined by the configuration of the device. The operations in the sequence are usually simple. It is the integration and coordination of many such operations into a single device that makes the system complex. Typical characteristics of fixed automation are:

- High initial investment for custom equipment,
- High production rates,
- Relatively inflexible in accommodating product changes [6].

The economic justification for fixed automation is found in products with very high consumption and volume requirements. The high initial cost of the equipment can be spread over a very large number of units, making the unit cost attractive compared to alternative production methods. Examples of fixed automation include mechanized assembly and machining transfer lines. Fixed automation is now synonymous with mass and high-volume production [6].

An example of fixed automation is screw manufacturing. It is characterized by the fact that the entire cycle is accompanied by single-purpose machines that are strictly designed for one activity and are not capable of operating another activity without major intervention in the machine design. This production is capable of producing thousands or more pieces per day. In Figure 3 can be seen screws leaving the production system on a conveyor belt [6].

Figure 3 Automated screw production [7]

4.2 Programmable automation

In this case, the production equipment is designed to allow the sequence of operations to be changed to suit different product configurations. The operational sequence is controlled by a program that contains a set of instructions coded so that the system can read and interpret them. New programs can be prepared and inserted into the device to produce new products. Some features that characterize programmable automation are:

- High investment in general-purpose equipment,
- Low production rate in relation to fixed automation,
- Flexibility in dealing with changes in product configuration,
- Most suitable for batch production [6].

Automated production systems that are programmable are used in low and medium volume production. Parts or products are usually produced in batches. To produce each new batch of a different product, the system must be reprogrammed with a set of machine instructions that correspond to the new product. The physical setup of the machine must also be changed: tooling information must be read, fixtures must be attached to the machine table, and the machine setup must also be changed. This changeover procedure takes longer. As a result, a typical cycle for a given product includes a period during which setup and reprogramming takes place, followed by a period in which a batch is produced. Examples of programmed automation include numerically controlled machine tools and industrial robots [8].

An example of programmable automation is the assembly of internal combustion engines, which can be seen in Figure 4, where the robot is able to perform several operations with unparalleled speed. In the event of a change in product range or activities, the robot can simply be reprogrammed to the new conditions without the need to interfere with its mechanisms or electrical wiring [8].

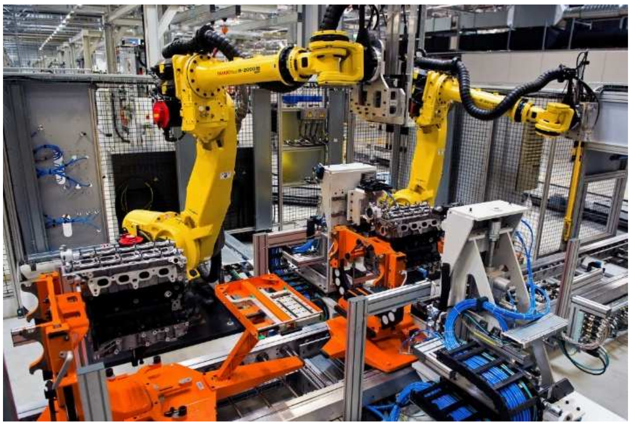


Figure 4 Automated assembly of an internal combustion engine [9]

4.3 Flexible automation

This is an extension of programmable automation. A flexible automated system is one that can produce a wide range of products and wastes virtually no time in changing from one product to another. There is no loss of production time when reprogramming the system and changing the physical setup of the machine. As a result, the system can produce different combinations and schedules of products instead of requiring the production of separate batches of individual products. The features of flexible automation can be summarised as follows:

- High investment for the customer system,
- Continuous production of variable product mixes,
- Medium production rates,
- Flexibility to deal with product design changes [6].

The basic features that distinguish flexible automation from programmable automation are:

- The ability to change sub-programs without loss of production time,
- Ability to switch physical setups, again without loss of production time [6].

These features allow the automated production system to continue production without the breaks between batches that are characteristic of programmable automation. Changing sub-programs is generally done by preparing programs off-line in a computer system and electronically transferring the programs to the automated production system. Therefore, the time required to program for the next job does not interrupt production on the current job. Advances in computer system technology are largely responsible for this programming capability in flexible automation. Changing the physical layout between parts is accomplished by switching them off-line while the next part is moved into position for processing. The use of pallet jigs that hold parts and transfer to the workstation is one way to implement this approach. For flexible automation to be successful, it is usually necessary to provide a more limited variety of parts than in a system controlled by programmable automation [6].

5 Automation options

When thinking about automation, it is important to consider whether automation will have the desired outcome. At the same time, it is essential to carry out feasibility studies from an economic point of view. It is necessary to define which benefits we want to achieve by automation and which negative features of the current non-automated production system we want to get rid of or minimize. These negative factors may include high labour costs, lack of skilled workers, lack of work safety, high overheads, etc. The reasons that lead to the decision to automate can be divided into several groups [10].

5.1 Forced automation

In cases where human labour is replaced by an automaton due to certain facts. Such reasons for replacing human participation in processes by automata may be as follows:

- Immediate presence poses a danger (often fatal) to humans, e.g. work in great depths, handling highly radioactive materials, work involving explosion hazards, work at extremely high temperatures,
- The direct presence of a person causes physical fatigue or the process has other adverse effects on him (heat, dust, moisture, shocks, noise) with possible health consequences - e.g. work in blast furnaces, mines, cement works, chemical plants, etc,
- Human activity is the cause of errors, the consequences of which lead to significant losses or are significantly adverse. E.g. automatic navigation of aircraft in fog during landing,
- Man is incapable of performing the required action in terms of accuracy, speed, scale or other causes. This is the case for controlling rockets, manufacturing chips or operating steam and combustion turbines,
- We have to use automated equipment because, for various reasons, a human being cannot be present to perform the activities in question. Examples include a heart simulator, automatic signal buoys in the sea or space probes,
- Automated machines perform the required tasks with a higher quality than a human. Examples include welding or painting industrial robots. These are able to guide movement more evenly and precisely, producing a higher quality final product,
- It is not possible to afford to tie up so much human labour, for example, automatic ticketing, automatic counters for the number of cars in a car park and thus the number of available spaces, or vending machines with snack machines that are able to serve customers at any time [10].

5.2 Economically justified automation

From the perspective of market economics, the following reasons can be considered:

- The use of an automated machine represents a reduction in unit and overhead costs compared to non-automated production. In particular, labour costs and material savings (the machine works more accurately and therefore produces less waste),
- The use of the automated production concept allows an increase in labour productivity and production volume, so we are able to produce more in less time compared to non-automated production,
- The use of automation equipment allows us to reduce the cost of production areas, storage space, machine wear and tear, administrative work and energy consumption,
- Automation promotes reduced production and development lead times. Through automation, it is possible to gain a competitive advantage over others,
- Automation can be more flexible to meet customer's wishes and win them over to buy more products.
- Automated machines can be used to provide products with certain functional features welcomed by the customer, so that the product can be sold to a wider range of customers,
- It is possible to achieve superior quality through automation, which can be reflected in an increased price of the product,
- Automated in-house information systems can give a certain competitive advantage. These are faster access to information, about customer needs or faster problem correction [10].

5.3 Other cases of automation

Apart from forced and economically justified automation, the following reasons can be described:

- The prestige of individual companies or institutions wishing to document their design, technical or financial capabilities and capacities
- The desire to provide human convenience, for example, any remote control of appliances or electronic devices that can be used by a non-expert
- A desire to provide a superior flow of information on the status of production equipment, production conditions, errors, etc.
- Ensuring an environmental standard that can be achieved without any limitations through automation. This includes various monitoring systems, control of optimum combustion to achieve minimum emission values, etc.
- Automation can also be a source and subject of entertainment, e.g. automatic draw devices, slot machines, sports simulators, etc. [10].

Acta Mechatronica - International Scientific Journal about Mechatronics
Volume: 7 2022 Issue: 4 Pages: 31-36 ISSN 2453-7306

6 Large automation

Automation considered to be large relies on the installation of classic industrial robots. These robots usually have a weight of more than 50 kg. They are installed in combination with a sophisticated safety system, which consists mainly of safety fences, but also optical barriers, sensors and elements that control all aspects of the production or assembly process. These include automation of handling, welding, surface treatment, palletizing or cutting processes. Due to the necessity to ensure safety by means of fences, larger groups of robots are preferably installed closely connected to conveyor systems, production machines, cleaning machines, etc. Installations fitting into the group of large automations are in most cases a matter of investment in the order of millions of CZK, therefore they are exclusively chosen in large-scale production where it is possible to achieve a return on investment within a few years or earlier. For these installations, only minimal modifications to the manufactured products are possible, primarily due to the mechanical capabilities of the entire system. The robots are installed according to the required load capacities and reaches, therefore it is not possible to change the production in terms of weight or size of the product. If the physical properties are maintained despite the change, modifications to gripping elements, fixtures in machines, on conveyors, etc. are usually unavoidable. Any change automatically generates costs associated with the modification of mechanical elements, electronics and pneumatics, where appropriate [11].

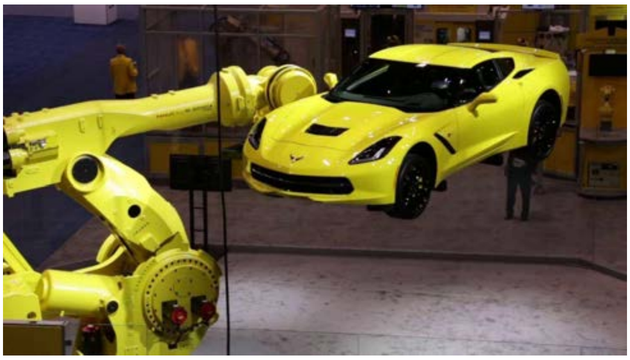


Figure 5 Robot with a load capacity of 2300kg [12]

Classical industrial robots have unrivalled performance that cannot be achieved by workers. These parameters can be described with a few examples:

- Maximum speed: 6 m/s,
- Maximum load capacity: 2300 kg,
- Maximum reach: a circle around the base with a radius of 4683 mm,
- Ability to work underwater,
- Ability to operate in life-threatening conditions.

7 Small automation

In contrast to large automation, small automation is characterised by the simple, unpretentious nature of the production or assembly process. It is based on collaborative or cooperating robots and has its application in mixed production, where small batches of highly individualised products are produced. They are ideal for automating sub-processes where a human is also present. The main characteristics of collaborative robots are slower speeds and the ability to stop on human contact. The principle behind this ability to stop lies in comparing the calculated load on the robot arm with the values obtained by a sensor that is part of the base. These features eliminate the need for safety fences and other features. Collaborative robots simulate a standing or seated human in size and are an affordable way to automate frequently repeated simple to trivial tasks. As the whole field of collaborative robots is still relatively in its infancy, collaborative robot legislation is largely incomplete and no one really knows how to deal with, for example, pinched fingers between a robot's gripper and a part of the product. The problem is that the robot stops, but only after it detects an overload and by then it may be too late [11].

Figure 6 Universal Robots collaborative robot [13]

The main advantages of collaborative robots are:

- Easier handling,
- Flexibility,
- Lower acquisition costs,
- Easier programming,
- Minimization of safety features.

8 Conclusions

This paper provided an overview of industrial automation in Industry 4.0. The paper can be divided into two parts. The first part described the automated manufacturing and assembly process, automated systems, their types, advantages and disadvantages. In the second part, automation options and reasons leading to the need for automation were described. Furthermore, the types of automation by size and their suitability according to the nature of the production system were described.

Acknowledgements
This paper was created with the subsidy of the project SGS-2021-028 ‘Developmental and training tools for the interaction of man and the cyber–physical production system’ carried out with the support of the Internal Grant Agency of the University of West Bohemia.

References
[1] TATLOCK, R.: DS Biovia, [Online], Available: http://www.3dsbiovia.com/about/news-pr/discoverant-pdf/2012/bioprocess-international-january-2012-manufacturing-process-automation-finding-a-pathway-forward.pdf. [20 Sep 2022], 2012.
[2] International federation of robotics, [Online], Available: https://ifr.org/ifr-press-releases/news/global-industrial-robot-sales-doubled-over-the-past-five-years [20 Sep 2022] 2021.
[3] ŠMEJKAL, L., MARTINÁSKOVÁ, M.: *PLC a automatizace. 1. díl, Základní pojmy, úvod do programování*, Praha, BEN, 1999. (Original in Czech)
[4] KHATIB, O., SICILIANO, B.: *Springer handbook of robotics*, Berlin, Springer, 2008.
[5] WEBER, M.: *What are automated manufacturing systems*, [Online], Available: https://connell-ind.com/what-are-automated-manufacturing-systems/. [20 Sep 2022], 2018.
[6] Types of automation production and operations management, [Online], Available: https://www.wisdomjobs.com/e-university/production-and-operations-management-tutorial-295/types-of-automation-9679.html [20 Sep 2022], 2018.
[7] KM Steel India, [Online], Available: http://www.kmsteelindia.com/fasteners-nut-washer-screws-bolts-manufacturing-process.html [20 Sep 2022], 2018.
[8] KOLÍBAL, Z.: *Roboty a robotizované výrobní technologie*, Brno, nakladatelství VUTIUM, 2016. (Original in Czech)
[9] Sync Robotics, [Online]. Available: https://www.syncrobotics.ca [20 Sep 2022], 2018.
[10] BENEŠ, P.: *Automatizace a automatizační technika 1: systémové pojetí automatizace*, Brno, Computer Press, 2012. (Original in Czech)
[11] MUSÍLEK, S.: *Automatizace v roce 2018*, [Online], Available: https://www.systemonline.cz/rizeni-vyroby/automatizace-v-roce-2018.htm [20 Sep 2022], 2018.
[12] Fanuc Robotics, [Online]. Available: https://www.fanuc.eu/cz/en [20 Sep 2022], 2018.
[13] National Aeronautics and Space Administration, [Online], Available: https://www.nasa.gov [20 Sep 2022], 2018.

Review process
Single-blind peer review process.

JOURNAL STATEMENT

Journal name:	**Acta Mechatronica**
Abbreviated key title:	Acta Mechatron
Journal title initials:	AM
Journal doi:	10.22306/am
ISSN:	2453-7306
Start year:	2016
The first publishing:	March 2016
Issue publishing:	Quarterly
Publishing form:	On-line electronic publishing
Availability of articles:	Open Access Journal
Journal license:	CC BY-NC
Publication ethics:	COPE, ELSEVIER Publishing Ethics
Plagiarism check:	Worldwide originality control system
Peer review process:	Single-blind review at least two reviewers
Language:	English
Journal e-mail:	**info@actamechatronica.eu**

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