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| miulogo    **جــــامــعـــةمــصــر الـدولــيـــة**    **MISR INTERNATIONAL UNIVERSITY**  Faculty of Engineering  Electronics and Communications Department  **EEG Wireless Controlled Wheelchair for Paralyzed or Elderly People**  **By:**  Ziad Ahmed Ibrahim 2018/03246  Jaidaa Adel Aly 2018/06393  Ahmed Sameh Fayez 2018/14728  **Under Supervision of:**  **Dr. Bassam Abdel Wahab**  This thesis is submitted as a partial fulfillment of the requirements for the degree of Bachelor of Science in Electronics and Communications  **Cairo 2023** |

**Abstract**

Our project intends to create an EEG-controlled wireless wheelchair system that provides a more intuitive and accessible mode of mobility for people who are paralyzed or elderly. Users can control the movement of the wheelchair with their thoughts by employing wireless EEG technology to detect and interpret brain signals, removing the need for traditional joystick or button-based controls. This device has the potential to dramatically improve the daily lives of people with mobility issues by allowing them to move more freely and confidently in their surroundings. We will investigate the practicality of this system by creating a prototype and conducting user testing to assess its efficacy and usability. Finally, we intend to provide a more inventive and user-friendly solution for people with mobility issues, enhancing their independence and quality of life.

This paper presents the development of an EEG wireless controlled wheelchair for paralyzed or elderly people. Brain waves drive the wheelchair, which are detected by an EEG headset. The headset is linked to a microcontroller, which converts brain signals into wheelchair commands. The wheelchair can be moved forward, backward, left, or right. It can also be halted. It is lightweight and portable, making it accessible to people with disabilities. The wheelchair is also reasonably priced, making it more accessible to a broader spectrum of people. The findings of this study show that EEG-operated wireless wheelchairs have the potential to increase the freedom and mobility of paralyzed or elderly people.

**Acronyms or Abbreviations**

BCW Brain Controlled Wheelchair

BCI Brain Computer Interface

EEG Electroencephalogram

KG Kilogram

GPIO General Purpose Input Output

IDE Integrated Development Environment

OS Operating System

AVR Alf-Egil Bogen Vegard Wollan RISC microcontroller,

USB Universal Serial Bus

PWM Pulse Width Modulation

AC Alternating Current

DC Direct Current

SRAM Static Ram

EEPROM Electrically Erasable Programmable Read-Only Memory

PLC Programmable Logic Controller

LED Light Emitting Diode

PID Proportional Integral Derivative

LUT Look-up Table

IC Integral Circuit

GND Ground

PNP Positive Negative Positive

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| NPN | Negative Positive Negative |

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| TTL | Transistor-transistor Logic |
| CPU | Central Processing Unit |
| RAM | Random-access Memory |
| BLE | Bluetooth Low Energy |
| CSI | Camera Serial Interface |
| DSI | Display Serial Interface |
| SD | Secure Digital |
| GB | Giga Byte |
| HQ | High Quality |
| MP | Mega Pixel |
| FPS | Frame Per Second |
| LXDE | Lightweight X11 Desktop Environment |
| CAD | Computer-aided Design |
| 3D | 3-Dimension |

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# Chapter One

# 1 Introduction:

## 1.1 Background

Neurotechnology advancements have created new opportunities for improving the quality of life for people who are paralyzed or older people who have restricted mobility. The development of an EEG-controlled wireless wheelchair, which uses brain signals to enable intuitive and efficient wheelchair control, is one possible use. This technology has enormous potential for empowering paralyzed or elderly people by granting them newfound independence and freedom of movement. This unique technology promises to provide a safe, dependable, and user-friendly form of movement by converting brainwave patterns into wheelchair commands tailored to the specific needs and capabilities of those with restricted physical mobility. This thesis delves into the design, development, and testing of an EEG wirelessly controlled wheelchair system, addressing technical problems, usability concerns, and the possible influence on the lives of paralyzed or elderly people. This study intends to contribute to the advancement of assistive technology by enabling enhanced autonomy and increasing the overall well-being of the target user group through extensive research and experimentation.

## 1.2 Problem Statement

Individuals who are paralyzed or elderly frequently face considerable challenges in preserving their independence and movement, resulting in a lower quality of life. Physical limitations caused by paralysis or age-related problems limit their capacity to complete everyday tasks, communicate with their surroundings, and participate in social activities. Traditional options, such as manual wheelchairs or carer help, are insufficient since they require external support and limit their liberty. Furthermore, mobility challenges associated with ageing might contribute to feelings of isolation, less social involvement, and a loss of personal freedom. Furthermore, existing assistive devices frequently fall short of providing paralyzed or elderly people with intuitive and efficient modes of mobility. Traditional wheelchair controls, such as joystick-based systems, may be difficult for people with low manual dexterity or cognitive impairments to use. As a result, there is an urgent need to develop novel solutions that enable paralyzed or elderly people to regain control of their mobility, interact with their surroundings, and improve their general well-being.

## 1.3 Motivation

Mobility is a crucial part of freedom and quality of life, yet many people with paralysis or mobility limitations struggle to move around freely. Paralysis is a life-altering condition that can have a negative influence on a person's physical, mental, and social well-being. It can make it difficult for them to move, communicate, and interact with the world around them, resulting in feelings of loneliness, frustration, and powerlessness. Traditional wheelchair designs can be challenging to use, especially for people with weak upper body strength or fine motor skills. Individuals with paralysis can nevertheless enjoy productive and meaningful lives with the correct support and resources. Our purpose is to develop technology and solutions that address the specific demands of paralyzed patients, allowing them to reclaim their freedom and autonomy. By using wireless EEG technology to drive a wheelchair, we can provide a more natural and accessible mode of mobility for paralyzed or elderly individuals, allowing paralyzed patients to overcome hurdles and reach their full potential. Our mission is to improve the quality of life for this demographic by providing them with the resources and tools they require to thrive.

## 1.4 History

Since ancient times, the history of epilepsy has been intertwined with the history of human existence. The first person to de-mystify the issue of epilepsy by offering a more scientific approach to it was Hippocrates, the founder of scientific medicine. Since then, several centuries have elapsed before electrical wave recording technology was used. close to the human brain and initially in experimental animals. The development of electroencephalography and the elucidation of underlying pathophysiological mechanisms were key factors in the emergence of epileptology.

### 1.4.1 The era of electroencephalography (beginning)

The development of electroencephalography (EEG) required first the discovery of electricity followed by the knowledge of the connection between electricity and living organisms. The discovery of static electricity was first attributed to Thales from Militos, a pre-Socratic "natural philosopher" of Greece, one of the seven wise men of that time, (around 640 or 620-550 B.C.), who generated friction using amber against silk or fur. After rubbing amber with hemp, Thales noticed the amber acquired an electrical charge and was able to attract light materials such as feather and dust. [1]

In 1672, the German physicist, engineer, and natural philosopher *Otto von* Guericke (1602-1686) developed the first electrostatic apparatus (a sulphur ball that rotated on a shaft to produce electrical fields) for basic animal experiments [2]. In 1745, the German Ewald Georg von Kleist (1700-1748) a Bishop of Pomern (Prussian) and physicist, and the Dutch scientist Pieter van Musschenbroek of Leiden (Leyden) (1692-1761) introduced the Leyden jar machine for storing static electricity (*a high voltage electric*). This friction machine could produce electricity (positive and negative electricity) but was not suitable for deriving electrical activity from the brain on to other electrical and electronic equipment. [3]

### 1.4.2 The nineteenth century

In 1890, Adolf Beck (1863-1942) a physiologist from Cracau wrote his dissertation on the cortex, entitled “Investigations into the Physiology of the Brain”. He electrically stimulated the brains of dogs and rabbits and argued that the brain had priority over the electrical activity of the body [4]. By using a galvanometer, Beck found constant electric activity in brain the brains of dogs and rabbits. Beck placed electrodes directly on the surface of brain to test for sensory stimulation. [5]

### 1.4.3 The twentieth century

In 1912, two Russian physiologists, Pavel Yurevich Kaufman (1877-1951), and Vladimir Vladimirovich Pravdich-Neminsky (1879-1952), noticed electric changes in the brain (first animal EEG) during experimentally induced seizures. They associated epileptic attacks with abnormal electric discharges in the brain and these observations were the beginning of clinical electroencephalography [6,7].

Twelve years later, in 1924, the German psychiatrist Hans Berger (1873-1941) managed to demonstrate neural oscillations in human brain and was the first to use the term electroencephalography [8]. From 1926 to 1929, Berger managed to establish a good EEG recording of alpha waves using a more sensitive double-coil galvanometer in cooperation with Siemens [9,10]. He described or touched upon a large number of normal and abnormal EEG phenomena, for example EEG changes associated with attention and mental effort.

Between 1920 and 1940 the technological and scientific foundations of electroencephalography were laid. EEG was established as the standard diagnostic tool in clinical practice, epilepsy research, and wherever the electrical activity of the brain is impaired [11]

## 1.5 Product features

1. User: Children, Adult, Elderly, Patients.
2. Controller: EEG Headset.
3. Load Capacity: 100KG.
4. Battery: lasts for around 2 hours.

## 1.6 Project Phases

### 1.6.1 Literature Review

A literature review is an in-depth examination of published literature and research papers on a certain topic or research question. It entails locating, assessing, and synthesizing existing scholarly sources in order to get a grasp of the present state of knowledge and research needs on a specific topic.

### 1.6.2 Project Requirements

* EEG Headset: An EEG headset capable of detecting brainwaves is required. Consider elements including comfort, electrode placement options, and compatibility with the control system of choice.
* Wheelchair Frame: A wheelchair frame that enables changes and integration of control system components. Check that it is compliant with the user's size and weight requirements.
* Microcontroller/Embedded System: A microprocessor or embedded system that is capable of processing EEG signals in real-time and operating the wheelchair's motor functions. Consider things like processor power, memory, and the number of available communication interfaces.
* Motor Control System: To translate EEG data into wheelchair movement, an adequate motor control system is required. Motor controllers, actuators, and other components may be involved.
* Power Supply: A dependable power supply option to power the wheelchair's control system, motor, and wireless communication module is required. Taking into considerations things like battery capacity, voltage management, and recharging choices.
* Sensors and peripheral components: Additional sensors and peripheral components may be required. Accelerometers, gyroscopes, temperature sensors, and user interface elements like buttons or switches could all be included.
* Wireless Communication Module: Selecting a wireless communication module, such as Bluetooth or Wi-Fi, to establish a dependable and low-latency link between the EEG headgear and the wheelchair's control system. Take into account the range, data transfer rate, and power consumption.
* Supporting Tools and Equipment: Making sure to have access to the tools and equipment needed for assembly, wiring, and testing, like a soldering iron, wire cutters, a multimeter, and prototyping boards.
* Development Software and Libraries: Determine which development software, programming languages, and libraries are required for the chosen microcontroller or embedded system. This could comprise signal processing software, motor control software, and wireless communication software.

### 1.6.3 Learning Phase

### 1.6.4 Collecting Materials

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# Chapter Two

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# Chapter Three

# Chapter Four

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