Chapter 6
Flexible Antennas for Wearable Technologies

Amal Afyf
Mohammed V University, Morocco

Fatima Riouch
National Institute of Post and Telecommunication, Morocco

Bellarbi Larbi
Mohammed V University, Morocco

Mohamed Adel Sennouni
University Hassan the 1st, Morocco

Yaakoubi Nourdin
Maine University, France

ABSTRACT

Having the merits of being light-weight, energy efficient, in addition to low manufacturing cost, reduced fabrication complexity, and the availability of inexpensive flexible substrates, flexible and wearable technology is being established as an appealing alternative to the conventional electronics technologies which are based on rigid substrates. Furthermore, wearable antennas have been a topic of interest for more than the past decade, and hundreds of scientific papers can be found on the subject. This large number of publications asks for some classification in order to get an overview of the trends and challenges. To this aim, an overview of antennas for wearable technologies is proposed. This chapter is organized into three major sections. In the first part, a detailed review of wearable antennas is presented. The second part of this project deals with the flexible antennas parameters and families. Materials and fabrication methods are discussed in the third part. Wearables advantages, disadvantage and challenges are summarized in the last section.

INTRODUCTION

The terms “wearable technology“, “wearable devices“, and “wearables” all refer to electronic technologies or computers that are incorporated into items of clothing and accessories which can comfortably be worn on the body. For example, one function of an activity bracelet takes raw data from a sensor, processes it and generates a report on the number of steps taken over a given period. Sensors track motion with enough intelligence to distinguish between steps and other movements.

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Sensors/ Antennas are an important part of wearable electronics, and continue to become smaller and more sophisticated. While there are many types of sensors that can be used, the most common is an inertial measurement unit (Accelerometer). An accelerometer can track a specific movement, its direction, and its intensity or speed. One simple example of an accelerometer is when a mobile phone or tablet (the input) is rotated and the device processes the movement and rotates the screen accordingly (the output). Other common sensors including pressure, temperature, position and humidity, support applications such as GPS. Consistently, wearable and flexible devices would often require the integration of antennas operating in specific frequency bands to provide wireless connectivity which is greatly demanded by modern information-oriented consumers. The aim of this study is to provide an overview of the current status and future perspectives in research and development of wearable technologies and sensors, to afford a comprehensive guide to various technologies and methods applied in the realization of flexible and wearable technologies along with state of the art antenna designs and implementations. Moreover, this document serves as an extensive reference in wearable topics. For these goals, it is necessary to define the field of wearable systems.

Wearable Antennas Background and Overview

History of Wearable Technologies

Wearable technology concerns any electronic products that are designed to be comfortably worn on the person as an accessory or as part of materials used in clothing. One of the major features of wearable technology is its ability to connect to the Internet, enabling data to be exchanged between a network and the device. Wearable technology is not a recent phenomenon, and dates back to head-mounted displays developed for helicopter pilots in the 1960s. Yet with recent advances in materials science that drive technology miniaturization and battery improvements, the global economy is standing on the brink of wider adoption of wearables. As computers have shrunk from room size to palm size, they have also moved from being passive accessories, such as laptops and personal digital assistants, to wearable appliances that form an integral part of our personal space. Wearable computers are always switched on and are always accessible. As computers move from desktop to coat pocket to the human body, their ability to help sort, filter and manage information will become ever more intimately connected to our daily lives. Applications of wearable technologies include wearable cameras, smart clothing, wearable apps platforms, smart glasses, health and happiness wearables, activity trackers, 3D motion sensors, and smart phone compatible watches (smart watches). In the past few years, many users often categorized these new devices as fun novelties and interesting gadgets. However, an increasing number of analysts consider wearable technologies to have more disruptive potential, to change existing industries, create new markets, and generate new jobs. As with smart phones, the possible applications of wearable technology are increasing and are closely connected to new developments in software and the emergence of the Internet of Things, the larger trend encompassing wearable technology. In Figure 1, a range of wearables' applications is illustrated.

There is a massive excitement in the industry about wearable technology. The marketing consultancy company WiFore, suggests that the "Wearable Electronics and Technology" market is estimated to exceed $14 billion in 2017, then double to reach $30 billion in 2020. Almost half of that will probably come from companies that are not players in today's consumer electronics market.