WIRELESS WEARABLE ELECTRONICS WITH HAND-FREE CONTROL AND ELECTRONIC SAFETY LED-DISPLAY ON CYCLIST

OMAR KHATAB IBRAHIM MAHMOUD KHATAB

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To Mom and Dad

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ABSTRACT

Wearable electronics is the future of the electronics devices, a great example would be Google with their product GOOGLE GLASS® or Apple with their product iWatch®. This Project aims to build a reliable system of wearable electronics to allow cyclist to have safer cycling experience. This project will be executed by designing the circuit and system, simulating the design using electronic circuit simulation tools and eventually building the prototype based on the simulation and design. This project aims to fabricate a relatively small PCB "2 cm x 3.5 cm" board to make it able to be worn as a wearable electronics; it also utilizes the ability of using the motion detector hardware, deriving the LEDs and also programming the microcontroller. A prototype of this wearable vest for a cyclist is fabricated to demonstrate the functionality of the system which is automatically detecting the motion of the user and displaying it on the LEDs. Experiments and tests were carried out to determine the reliability of the system.

ABSTRAK

Elektronik yang boleh pakai adalah masa depan peranti elektronik, contoh yang baik akan menjadi Google dengan kaca atau Apple dengan jam tangan mereka. Projek ini bertujuan untuk membina sistem yang boleh dipercayai elektronik boleh pakai untuk membenarkan pelumba mempunyai pengalaman berbasikal lebih selamat. Projek ini akan dilaksanakan dengan mereka bentuk litar dan sistem, simulasi reka bentuk dengan menggunakan alat simulasi litar elektronik dan seterusnya membina prototaip berdasarkan simulasi dan reka bentuk. Projek ini bertujuan untuk membina papan litar tercetak (PCB) dengan size 2.5 cm x 4.5 cm supaya senang dipakai sebagai elektronik boleh pakai; ia juga menggunakan keupayaan menggunakan perkakasan pengesan gerakan, memperolehi LED dan juga pengaturcaraan pengawal mikro. Prototaip ves berbentuk elektronik boleh pakai untuk penunggang basikal direka khas untuk beroperasi secara automatik mengesan pergerakan pengguna dan memaparkan isyarat pada LED. Eksperimen dan ujian telah dijalankan untuk mengenalpastikan kebolehpercayaan system.

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IEEE	Institute of Electrical and Electronic Engineering
LED	Light Emitting Diode
SMD	Surface-Mount-Device Light-Emitting Diode
PCB	Printed Circuit Board
PIC	Peripheral Interface Controller
LiPo	lithium polymer
Tx	Transmitter
Rx	Receiver
V	Volt

CHAPTER 1

INTRODUCTION

1.0 GENERAL BACKGROUND

Cycling is an economical and enjoyable mode of travel, whether you're riding down to the corner store or commuting across town to work. It can also be dangerous, especially for beginners cyclists who decide to ride on the road. Many cycling accidents and injuries are caused by improper safety precautions or not being familiar with the rules of the road. Many can also be the fault of other vehicles or pedestrians. Every year around 19,000 cyclists are killed or injured in reported road accidents, including around 3,000 who are killed or seriously injured[1][2].

Cyclists who want to notify the road users of stopping or turning intentions have to use their arms, but that’s not the convenient or safe way to do so. The lights that are attached to the rides is very hard to detach and carry them to keep them away from the hands of opportunist thieves can be a bit of pain. A sleeker idea would be integrated with a wireless radio frequency module and a lighting system into the cyclist safety vest is the solution which is going to be presented in the following project.

The vest uses wireless radio frequency module to connect to the transmitter in the cyclist helmet through his actual movements. This allows it to detect and reflect in real time the rider's movements at traffic lights and turnings. Lights will be placed on that vest and the lights are controlled remotely so they indicate clearly the intents to turn right or left when you are riding your cycle. This project aims and expects to bring sanity onto our roads, and hopefully it will help to reduce the amount of accidents that are happening these days.

With the rapid growth of technology through the past few years, electronics devices are becoming smaller and smaller by time and becoming more user friendly. Electronics devices have been wide spread among almost everyone these days and that's due to their functionality and its durability. Now electronic devices interact with the human beings better than ever which leads the engineers to push the boundaries of the electronic devices and give more innovation in the field of electronic conceivable outcomes.

One of the best illustrations for the progression of innovation is the development of wearable electronics. Wearable technology is related to both the field of ubiquitous computing and the history and development of wearable computers. With ubiquitous computing, wearable technologies share the vision of interweaving technology into the everyday life, of making technology pervasive and interaction friction less. Through the history and development of wearable computing, this vision has been both contrasted and affirmed. The history of wearable technology is influenced by both of these responses to the vision of ubiquitous computing [3]. In another words, electronic devices are worn on our body in various ways to provide an easier way to perform a task. From initial discoveries, we have now reached the rapid phase of development in wearable electronics. This is because the cost of some of the most significant microelectronic components is low enough and the available technologies are developed enough to execute this vision [4].

Wearable Technology is on the rise in personal and business utilization. Google Glass is a much noted device, offering promising technology but to many, pricey and awkward in use. Smart watches so far have not been deployed much, as limited functionality and inconvenient style may get in the way. Some other devices are already in use, others still on the horizon that wearable could be useful in professional and patient settings.

Wearable device now becoming smarter than ever as it incorporates into things we wear on the daily basis and it could be a smart watch, augmented reality glasses or even a personal health monitor in the form of a bracelet. Actually with the era that we are living in, the technology increased to be a part of the daily lives and it became less intrusive as it is became a part of our clothing and sometimes even a part of our bodies, and that what am going to introduce in this project.

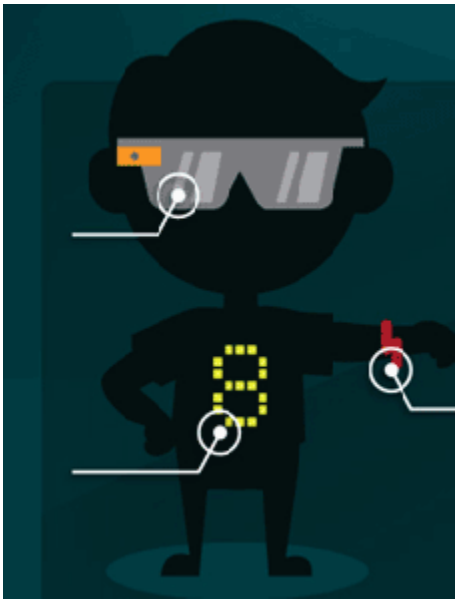

Figure 1.1: Wearable devices example

1.1 PROBLEM STATEMENT:

As engineers we are committed to make the roads safe for all users. There are a lot of ways in which a cyclist can become involved in an accident; one of the most dangerous ways is to trying to reach your phone or to do any task while cycling therefore a hand-free control will be used in this project which gives you better control of the output signal.

Following this, engineers and researchers spent hours trying to figure out how to reduce the size of the electronics components, market demand is growing for electronic parts that are built smaller and at lower costs than their predecessors, Reductions in size and cost drive innovation in PCB technology. Embedding components can help reduce the size of the board assembly. It also can potentially reduce the manufacturing cost for complex products. Minimizing electrical path lengths to reduce parasitic effects is critical when dealing with high-frequency circuits. Reducing the wiring length of passive components to an IC can decrease parasitic capacitance and inductance, reducing load fluctuations and noise within the system.

So we are going to use wearable electronic device. Since big rigid components on PCB cannot be used as a wearable device because of the size and unconventionality to be worn it is going to be replaced by a flexible electronics on cloth as a wearable electronic and it is going to include fixable LEDs, It is going to be very durable and small in size and also it is going to be wirelessly communicated through radio frequency modules with the output. Adding to that the reliability of the wearable electronics in the market does not serve this chapter well and if it does it need improvement and modification to suit the needs of the cyclist.

1.2 OBJECTIVES:

The objectives that this project aims to accomplish;

1. To design wearable electronic with a hand-free control electronic safety LED-display on cyclist by use of block diagrams and electronic circuit design tools.

2. To simulate the designed system using electronic circuit simulation tools such as MultiSim and MPLab.

3. To fabricate and test the wearable electronic circuits based on the simulation done during the simulation phase, using components included during the designing phase.

1.3 SCOPE OF WORK

This project will include tilt sensors, a microprocessor that will analyze and calculate the analog input plus an indicator to display the digital output. User's movement will be detected and analyzed by the tilt sensors and will be displayed on a 20cm x10 cm LED display which will be flexible because a roll of SMD LEDs which will contain around 60 LEDs will be used and all of that from the information fed through the computer system. Moreover, the system is going to have a radio frequency module that will send all the information from the input circuit to the output circuit wirelessly. This project will be limited to indicating direction through the movement of the user and displaying the data accurately through LEDs. The sensors, microcontroller, LEDs and other components to be use in this project are obtained off the shelf and are ensured to follow the electrical requirements of the system.

1.4 REPORT STRUCTURE

This thesis incorporates five chapters with its own particular extent of clarification in regards to the venture which is the project.

The first chapter is the introduction to the project, which includes the general background, motivation deduced from the problem statement, objectives and scope of project.

The second chapter assembles the literature review that is connected and referenced to the project. This chapter concentrates on other expert explores and work that has been archived as to give a viewpoint to this undertaking project.

Chapter three recorded the methodology utilized as a part of the fulfillment of this task. It definite the research approaches and testing strategy that has been executed in attaining the conclusion.

For chapter four it will show the result and the analysis based on the outcome of the project. This will happen after the system is complete and all the circuits are combined as a one full system than all of them work together in more than one way of transmission to deliver the desired outcome.

Chapter five will conclude all the work done for this project and discussing will be made in order to highlight the difficulties and how to overcome it and also to suggest how to improve the project, furthermore future work will be added to create an opportunity for other to have idea what is wearable electronics and how it is important in the next few years.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter provides an overview of relevant literatures as well as the basic theoretical idea of a wireless wearable electronics. The chapter begins with a brief history on the wearable devices, followed by studies on the related scope of wearable electronics after that the improvements which are going to be implemented in this project and finally the hardware that is going to be used in this project.

2.1 WEARABLE ELECTRONICS

At first, the start was not easy at all for wearable devices, it was a roomful. Then it shrunk down to a desk top. And later it moved to our laps, palms and our attire. The whole history was not just the history of wearable devices but also the history of several misses and a few hits, this history offers some impression of what one can expect in wearable processing.

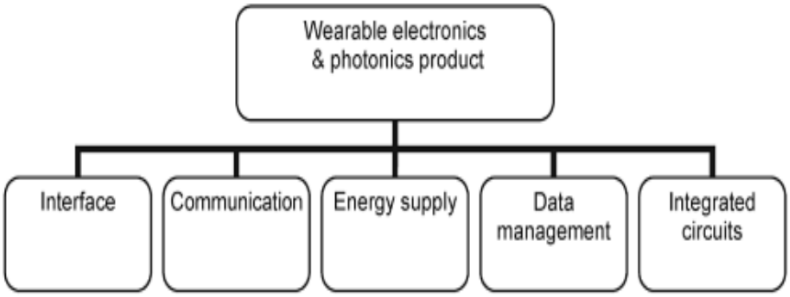

Figure 2.1: A general system configuration of a typical wearable electronics

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. These wearable devices can perform many of the same computing tasks as mobile phones and laptop computers; however, in some cases, wearable technology can outperform these hand-held devices entirely. Wearable technology tends to be more sophisticated than hand-held technology on the market today because it can provide sensory and scanning features not typically seen in mobile and laptop devices, such as biofeedback and tracking of physiological function (3).

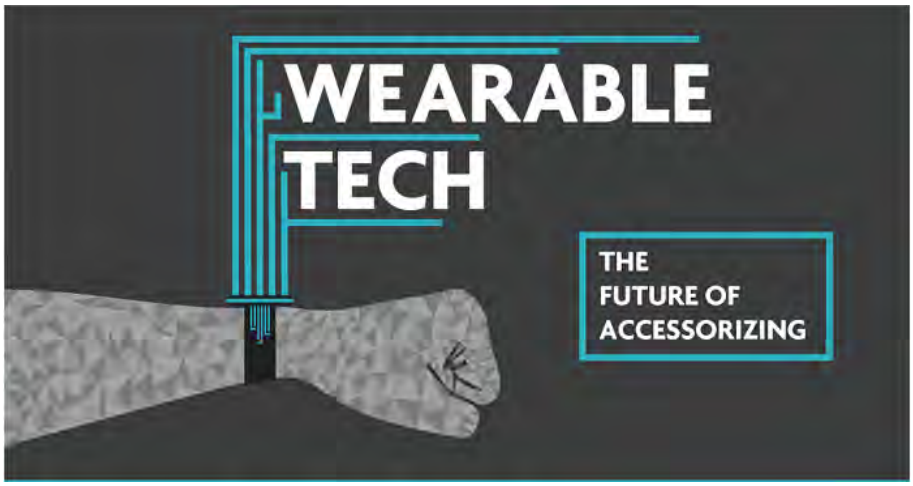

Figure 2.2: wearable technology example and goal

2.2 HAND-FREE COMPUTING

Hands-free computing is any computer configuration where a user can interact without the use of their hands, an otherwise common requirement of human interface devices such as the mouse and keyboard. Hands-free computing is important because it is useful to both able and disabled users. Speech recognition systems can be trained to recognize specific commands and upon confirmation of correctness instructions can be given to systems without the use of hands. This may be useful while driving or to an inspector or engineer in a factory environment. Likewise disabled persons may find hands-free computing important in their everyday lives. Just like visually impaired have found computers useful in their lives [5].

This can range from using the tongue, lips, mouth, or movement of the head to voice activated interfaces utilizing a lot of commands through wire and wireless technology. Wireless technology includes Bluetooth, Zigbee and radio frequency modules.

2.3 HISTORY OF WEARABLE DEVICES

Contrary to popular beliefs, wearable devices aren't a new idea of innovation. Although the technology used for these devices are ever-changing and their sizes generally become smaller, the idea itself stretches back to the 1960's.

In 1961, Mathematician Edward O Thorp and Claude Shannon invented a roulette predictor that used a cigarette pack-sized analogue computer with four push buttons to indicate the speed of the roulette wheel. In the same decade, a wearable lip-reading aid was invented by Hubert Upton an engineer that helps users read lips better through an eyeglass mounted display.

About ten years later, a wearable camerato tactile vest for the blind was invented by CC Collins where a head-mounted camera converted images into a 1024-point, 10-inch square tactile grid on a vest. In the same year, Hewlett-Packard (HP) company invented the algebraic calculator watch complete with a stylus that snapped into the clasp of the bracelet. A backpack-mounted computer used to control photographic

equipment was invented in 1981 by Steve Mann. This body-hugging device was actually a 6502 computer wired into a steel-frame backpack to control flash-bulbs, cameras and other photographic systems.

The wearable technology progresses further in the 1990's. An Active badge was invented by the researchers in Olivetti Research, UK in the early 90's that uses infrared signals from a small transmitter attached to the user's clothing to locate the person in a building. Three years later, the first wrist computer was invented by Edgar Matias and Mike Ruicci from the University of Toronto, built from a modified HP 95LX palmtop computer. The first "Smart Clothes" fashion show was held in Pompidou Center, Paris in 1997 involving the students and faculty of Creapole Ecole de Creation, Paris, and Prof Alex Pentland of MIT, Boston, USA.

In the present time, the most exciting wearable device invention is the Google Glass invented by Google Inc. in 2013. This wearable computer has the ability to take photos and record 720p HD video The side of Google Glass is a touchpad, allowing users to control the device by swiping through a timeline-like interface displayed on the screen.

2.4 PREVIOUS PRODUCTS

At the present scenario, there are some products that serve the same field of the wearable device that is implemented in this project, it will all be explained in the next few lines below and I am going to discuss the pros and cons.

A lot of previous products have been introduced to the market as a promoter of safety on the road, some of them served the purpose well but some of them did not, to overcome all of the mistakes occurred or implemented in the project a new product will be fabricated to serve the market with a latest technology.