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MICROCONTROLLER-BASED KURDISH UNDERSTANDABLE AND READABLE DIGITAL SMART CLOCK

Karwan M. Hama Rawf [a,*], Ayub O. Abdulrahman [a]

[a] Dept. of Computer Science, College of Science, University of Halabja, Halabja, Kurdistan Region, Iraq
(karwan.hamaraouf@uoh.edu.iq; ayub.abdulrahman@uoh.edu.iq)

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ABSTRACT:

A smart clock is any digital clock that has at least one intelligent feature. Moreover, it provides time with synchronizing automatically base on the standard measurement, which is determined during the implementation software on the hardware architecture design. This study presents an efficient cost-effective smartwatch for disable people based on the Atmega328p microcontroller (Arduino Uno) that is programmed in "Arduino" (C based) programming language. Moreover, the system uses DS1302 real time clock, SD card memory, push button, voice recognition module, liquid crystal display (LCD), and sound speaker. The clock sounds time in Kurdish language when a related switch is pressed or asked via microphone, it also shows the time on LCD. Finally, the system is applied successfully with a satisfactory cost and performance for the proposed application according to the achieved test results.

Keywords: Smart Watch, Wearable system, Kurdish Sound Recognition, Liquid Crystal Display, Microcontroller, and "Arduino" (C based) programming.

1. INTRODUCTION

Nowadays, the number of people that have near or distance vision disablement is about 2.2 billion people. Approximately half of this number has not been registered. However, the massive number of blindness and vision deficiency people are 50 years old and above, everyone in all ages might face losing vision (WHO, 2021). These cases can make daily life routine difficult. Moreover, enhancements of technology and improvements in Computer-Based Systems have made life easier and simpler. Currently, Smart watch technology has been developed dramatically from the classical structure to Artificial Structure (Kim & Shin, 2015)

Analog clocks, digital clocks, auditory clocks, and textual clocks are known as the four types of clocks based on time display methods. Digital clocks are the common type of clock, which use numeric representation of time. Furthermore, electronic clocks have two types of display formats; 24-hour representation with 00 to 23 hours ranging and 12 hours representation with AM/PM indicator. In addition, portability, reliability, accuracy and easy maintenance are the main characteristics of electronic clocks over mechanical clocks. Digital Clock is a Microcontroller-Based system, which is designed and implemented by special software to execute its instructions.

The proposed research paper is distinguished from other papers related to smart watches due to its ability to understand Kurdish sign language and read the time in Kurdish Language. This helps the major aspect of society known as blind people to check the time via asking the system or pushing a sound button. Furthermore, the system characteristics are included: cost effective, easy setting controller, and protecting from physical damages.

1.1. Research Aim and Objective:

The purpose of the proposed system is to construction a wearable smart watch to check the time through two ways, sound and push button, both techniques are simple and easier especially to blind and uneducated people that users can hear the time in Kurdish Language. The system is also useful for drivers to check the time and avoid fatal crashes (Liu et al, 2015) (Emroch & Kilduff, 2020)

1.2. Related Work

Smart watches are the new generation of investigating watches that use microcontrollers. Recently, the design and implementation of wearable smart watches required more power utilisation (Bieber et al, 2013) The performance and functionality of wearable smart watches are changed depending on the kind of the watch. Different watches offer numerous roles; the proposed smart watch offers a service to check the time to blind and older people. It is also useful for any other dark position or driving situation.

Henlin, P. (2012), proposed a digital clock based on the PIC16F877A microcontroller with using c programming language to obtain accurate result in exact time through seven-segment and LEDs (Henlin, P. 2012). (K. Minatani, 2014) designed the first wristwatch renewable braille watch, which consists of 16 input switches and 8 braille cells. Furthermore, the shape of the system has been enhanced as a wristwatch and voice mixture technique is used as the output. Wristwatch-style renewable braille presentation is developed to support voice and braille output. Moreover, assistive technology vendors have been used to enhance refreshable braille displays and reduce the impact of predictable braille presentations, which is too huge for mobile applications. Therefore, connecting the system to computers with the different platforms is arranged via Bluetooth protocol (K. Minatani, 2015). However, it's difficult to find standard benchmark tests to assess the performance of such types of studies. (Kazunori Minatani, 2016); enhanced a particular way to achieve the measurement of speed response for executing different braille characters in the hardest workload situation. Furthermore, usability of recognition may be reduced from the voice of devices in a

* Corresponding author

public area due to distribution of concentration between outdoors voice and device sound output.
As it is clear, most of smartwatches are created for commercial purpose especially in the field of sport, such as variant smartbands (Li et al, 2014) So, they are known as secondary features of the smartphones. Therefore, there are many researches were combine architectures and features of smartwatch with smartband cooperating with smartphones (González-Cañete, & Casilari, 2021)

1.3. Research Contributions

The appropriate user interface may not be designed for blind persons to check the time without using mobile computer applications. However, there are several papers available that work on the braille system for blind people as mentioned in Related Work. Those systems may not be suitable to use for every eyeless person due to the variety of techniques of braille systems. Also the size and heaviness of updating braille presentation are not compatible with wearable systems (HandyTech, 2021) In addition, there are lots of architectures of microcontroller-based smart clocks in other languages, but blind people cannot achieve the efficient smart clock to read the time in Kurdish language. The two main characteristics of such a type of system are; easily to use and accurately in result. The remaining section of the paper is arranged as follows. Section 2 contains methodology which includes design hardware and software in detail. Results and Discussion will be described in Section 3, and finally, conclusions and future work are presented in Section 4.

2. METHODOLOGY AND MATERIAL

The proposed system is designed as a microcontroller-based smart clock to check time using two different techniques, push button and speech understandable, which can read time in Kurdish language and shows it on LCD. In this section, designing and Implementation of smart watch systems for blind people will be illustrated in detail. A block diagram of the system is shown in Figure 1.

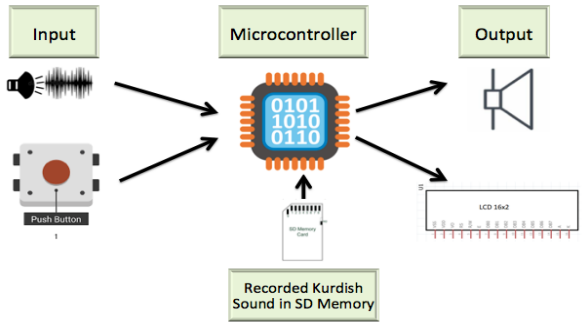

Figure 1. block diagram of the smart clock

2.1. Architecture Hardware design

The proposed architecture design has an easy structure to use and a cost-effective system; also, the system can be used as a digital clock or wearable smart watch. The attached materials, which are used in this study; can be effortlessly available and easily maintained. The initial parts of the system are input device, microcontroller, SD card memory, and output devices. Input devices are used to ask the system to check the time through push button and/or microphone, and also the output devices will be used to present the instant time from LCD or read recorded sound of SD card from speaker.
In addition, the main aspect of achieving an efficient result of this study is using physical items, which are known as system hardware. For such a type of study Microcontroller, sensors, and actuators are primary items that are required for executing proper instructions. Indeed, it is recommended to use a microcontroller to embed in the system because it includes subsequent characteristics: implementing simple, low-cost, and portable (Ardito et al, 2021). ATmega328P is a Pico-power 8-bit microcontroller based on the AVR modified RISC architecture. It has reached 1MIPS per MHz that is significant to improve power consumption (ATmega328, 2021). In addition, the raw data can be collected from different input devices from the outside of the microcontroller such as; push buttons are used to set the system and ask for instant time, microphone is used to check the time through Kurdish voice, and SD card memory is used to collect data as a dataset. Furthermore, the processed data can be presented via output devices, the proposed system determined speaker to announce the current time and liquid crystal display (LCD) is used to show date and time. Besides, a real time clock (RTC) is the auxiliary device for the system to calculate date and time whenever the system is powered off. The hardware system design is shown in Figure 2.

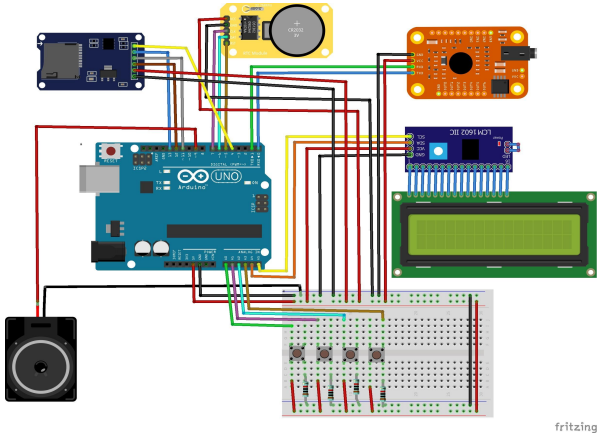

Figure 2. Hardware system Design

2.2. Software

The hardware architecture requires system software to implement instructions. The proposed system has used Arduino programming language because it is an open-source environment, it works on multiplatform, and easy to write code and maintenance (Arduino website, 2021). Serial communication is used to upload the code to the Arduino board from a computer device. VoiceRecognitionV3, DS1302, LiquidCrystal_I2C, SPI and SD are five libraries that have been used to communicate with the hardware architecture. The aim of this study is to check the time accurately using Voice Recognition Module V3. This research uses voice commands to show and read current date and time automatically. Also, voice commands have been taken in Kurdish languages based on requirements for smart watches. The DS1302 real time clock is a brilliant integrated circuit for calculating date and time (Zhang et al, 2014) DS1302 C-based library is used to operate the chip. Although an I2C communication has been selected to interface a LCD with the system, the aim of using I2C is to decrease a connection pin number of LCD that uses two analog pins A4 (SDA) and A5 (SCL) rather than using eight I/O pins. For that reason, LiquidCrystal_I2C library is used to control the LCD. Finally, SPI and CD libraries are two other libraries that are used for communicating with the SD card. The proposed system illustrates a clear structure of system software to implement on hardware architecture to investigate intelligent clocks. The system process is shown in the following flowchart diagram.

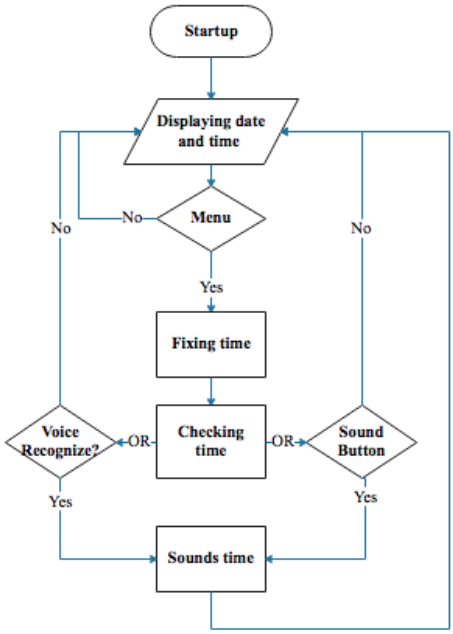

Figure 3. Flowchart Diagram of the Proposed System

3. RESULT AND DISCUSSION

The proposed smart watch has been tested after integrating hardware architecture and software system precisely. At the beginning the LCD screen shows the current date and time when the system is powered on. If the initial time is not accurate, three push buttons are used to fix date and time on the system. Otherwise the first step of testing will be started to hear the instant time in Kurdish sound. The process happens by pushing the sound button and/or asking from the voice recognition microphone, after those inputs process, the system checks the time by reading the dataset Kurdish commands through the sound speaker. After testing the previous steps on the proposed system several times, a reasonable result has been achieved. Obviously, the proposed system is the first paper in this area, so the result of this study can be a benchmark for other studies in Kurdish understandable and readable smart watches. The purpose of this study is to implement smart watches with different instructions compared to the other studies in the wearable system area.

(Peter Henlin, 2012) uses a PIC16F877A microcontroller with C program language to build a digital clock that displays the time through the seven-segment display. In addition, a digital alarm clock has been designed by using STC89C52 microcontroller; the system also includes DS1302 real time clock to calculate the time, DS18B20 sensor to measure temperature, and 16X2 LCD to display the time (M. Yin, 2018). (Kazunori Minatani 2014,2015,2016) has improved a wristwatch renewable braille that is known as the Braillet in three sequential conferences as it is mentioned in section 1.2 Related Work. As it is clear, disable and older people demand to check the time easily, for that reason, the proposed system has been designed with a particular digital clock that has variant characteristics compared to the other systems. Moreover, the system corresponds to the demand of the people; hence it has Kurdish sound recognition facility except for the push button, which is different from other wearable systems. The vital point of this study over braille wearable system, users can check the time without touching the system, thus it is useful for handless, elderly people, uneducated, and blind people. Furthermore, the difference in system architectures and the number of components used to build the proposed smart clock causes significant performance among the compared smartwatch systems.

In addition, a usability test is one of the real significant techniques to evaluate user interface of platform and system. However, researchers use a lot of usability approaches to real access systems, User based methods are one of the perfect methods of usability techniques. The proposed system is evaluated by user-based methods as shown in table (1).

Table 1. user based methods evaluations

	User based method (Time in Seconds)		Usability Criteria	
Task users	Voice Recognition	Push button	Performance rate	satisfaction
1st user	1.54	1.3	100%	Good
2nd user	1.29	1.10	100%	Excellent
3rd user	1.46	1.2	100%	Good
4th user	1.53	1	100%	Very Good

4. CONCLUSION AND FUTURE WORK

Most of the recent studies on this area concentrated on utilizing physical touch to the wearable system such as different braille systems. In contrast, the proposed system provides other alternatives to the physical touch, which is Kurdish sound understandable and readable smart clock. The system also offers a push button facility to check the time and display it on LCD. Furthermore, cost reduction and easy maintenance are the two distinguishing characteristics of this system from the others, because of using cost-effective components and simple structure.

In future work, the system can be developed to connect with the mobile application through Wi-Fi and/or Bluetooth to set the time and transfer data. Moreover, presenting time will not be the main function of wearable systems, but it could offer extra features such as health monitoring, and notification display alarm.

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