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CLOUD-BASED REAL-TIME AND REMOTE HUMAN ACTIVITY RECOGNITION SYSTEM USING WEARABLE SENSORS

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ABSTRACT
In this project, we propose a cloud-based real-time human activity recognition system.First, we develop a wearable system that contains an Accelerometer sensor, Heart beat sensor,an Arduino and a WIFI module in order to sense human movement and heart rate of human body. Whatever the data created stored in cloud using Internet of things (IOT). And also displaythe data in Lcd display. If the Heart beat increases due to any Health issue the buzzer rings automatically, which help for easy Notification. The proposed system is able to achieve an average of 93% accuracy in classifying the different activities efficiently.

1. INTRODUCTION
The last decade has seen some great amount of research-oriented activity in the field ofhuman activity recognition (HAR). The activity recognition becomes more matured with consistent advancement in technologies. By incorporating many types of wearable sensors anda suitable communication medium, we can efficiently monitor and recognize the movement ofa person in day-to-day life. Wearable sensors are the sensors which are integrated into wearableobjects or directly to the body to monitor the activity or to provide the medically related data of a person. The market of wearable sensors was valued at 9 billion US Dollars globally in 2018, and it is expected to reach a whopping 26 billion US Dollars by the year 2025 at an increasing rate of 19 percentage. These sensors are used in various domains starting from healthmonitoring applications to gaming industries. The wearable sensors that are generally used forHAR applications are accelerometer, gyroscope and pedometer. In this paper, we explain the development of an end-to-end HAR system – from data acquisition to data classification – developed using a single sensor, a flexible cloud framework and a simple classification algorithm. The specific features of the proposed system are –

- Real-time data acquisition and storage in cloud
- Wireless transmission of sensed data
- Remote monitoring and analysis, thus, always maintains ubiquity of the end-users
- Optimized resource (cost, power and size) consumption

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2. LITERATURE SURVEY

Some recent research works presented a detailed review of human activity recognitionsolutions based on wearable sensors from different angles, involving the adopted sensors, recognition approaches, and application scenarios. From these, we can see that inertial sensor, especially accelerometers, are the most commonly used wearable sensors for action/activity recognition due to their ability to measure attributes related to the user's movement. Bao et al.used five two-axis accelerometers worn on the user's right hip, dominant wrist, non-dominantupper arm, dominant ankle, and non-dominant thigh to recognize 20 different activities using decision tables, instance-based learning, C4.5, and naïve Bayes classifiers. They claimed that a recognition accuracy of over 80% on a variety of 20 everyday activities was achieved and multiple accelerometers aided in recognition. This study was one of the most classic works inthe early days of HAR research based on wearable sensors, and the framework it proposed became an important reference for follow-up research works.

Since then, some similar HAR systems, requiring users to wear four or more accelerometers or carry heavy recording devices, were presented. However, wearing too manydevices is obtrusive and intrusive and can cause additional burdens to users. As smartphones are increasingly popular, they become an integral part of people's daily life. A growing numberof studies began to adopt smartphones for context-aware activity recognition in pervasive andubiquitous environments, benefitting from their embedded various sensors and lightweight, portable characteristics. The research works presented different approaches to recognize various human activities using smartphone sensors. Additionally, Paul et al.took the sensor readings from mobile sensors as inputs and predicted a human motion activity using online classification algorithms; Cao et al. proposed an efficient group-based context-aware classification method for human activity recognition on smartphones. These two studies carriedout online activity recognition on smartphones using the embedded sensors, thanks to their ever-growing computing, networking, and sensing abilities. Likewise, as another kind of commonly used wearable device, wrist-worn devices represented, for example, by smartwatches or wristbands, are employed to provide HAR solutions using their embedded accelerometers, gyroscopes, magnetometers, or even heart rate monitors.

3. ARDUINO:

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

The ATmega328 microcontroller contains 32 general purpose working registers. As shown in the below figure these registers are directly connected to ALU. Two registers can carry one single instruction consequently in one clock cycle.

3.1 Specifications:

Table 3.1: Atmega328 specifications

Microcontroller	ATmega328P – 8-bit AVR family microcontroller

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Operating Voltage	5V
RecommendedInput Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 Ma
DC Current on 3.3V Pin	50 Ma
Flash Memory	32 KB (0.5 KB is used for Boot loader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

3.2 ARDUINO:

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (U), which is used to write and upload the computer code to the physical board.

The key features are −

- Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.
- You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).
- Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.
- Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.
- Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

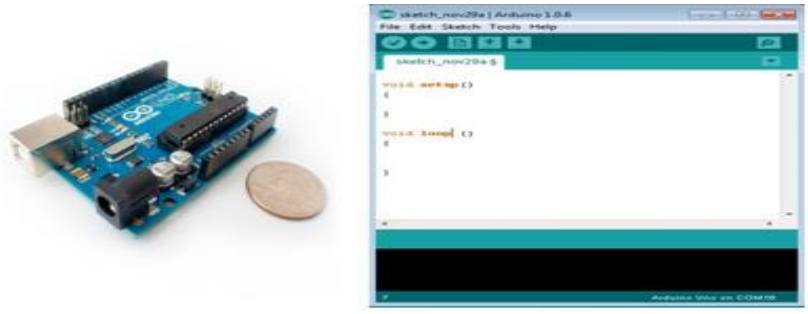

Figure 3.1: Arduino Uno

3.3 BOARD TYPES:

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Various kinds of Arduino boards are available depending on different microcontrollers used. However, all Arduino boards have one thing in common: they are programed through the Arduino IDE.

The differences are based on the number of inputs and outputs (the number of sensors, LEDs, and buttons you can use on a single board), speed, operating voltage, form factor etc. Some boards are designed to be embedded and have no programming interface (hardware), which you would need to buy separately. Some can run directly from a 3.7V battery, others need at least 5V.
Here is a list of different Arduino boards available.

Table- Arduino boards based on ATMEGA328 microcontroller

Table 3.2: Arduino boards based on ATMEGA32u4 microcontroller

Board Name	**OperatingVolt**	**Clock Speed**	**Digital i/o**	**Analog Inputs**	**PWM**	**UART**	**Programming Interface**
Arduino Uno R3	5V	16MHz	14	6	6	1	USB via ATMega16 U2
Arduino Uno R3 SMD	5V	16MHz	14	6	6	1	USB via ATMega 16U2
Red Board	5V	16MHz	14	6	6	1	USB via FTDI
Arduino Pro 3.3v/8 MHz	3.3V	8MHz	14	6	6	1	FTDI-CompatibleHeader
Arduino Pro 5V/16MHz	5V	16MHz	14	6	6	1	FTDI-CompatibleHeader
Arduino mini 05	5V	16MHz	14	8	6	1	FTDI-CompatibleHeader
Arduino Pro mini 3.3v/8mhz	3.3V	8MHz	14	8	6	1	FTDI-CompatibleHeader
Arduino Pro mini 5v/16mhz	5V	16MHz	14	8	6	1	FTDI-CompatibleHeader
Arduino Ethernet	5V	16MHz	14	6	6	1	FTDI-CompatibleHeader
Arduino	3.3V	8MHz	14	8	6	1	FTDI-

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Fio							Compatibl eHeader
LilyPad Arduino 328 main board	3.3V	8MHz	14	6	6	1	FTDI-Compati
LilyPad Arduino simple board	3.3V	8MHz	9	4	5	0	FTDI-Compatibl eHeader

3.4 BOARD DESCRIPTION:

In this chapter, we will learn about the different components on the Arduino board. We will study the Arduino UNO board because it is the most popular board in the Arduino board family. In addition, it is the best board to get started with electronics and coding. Some boards look a bit different from the one given below, but most Arduinos have majority of these components in common.

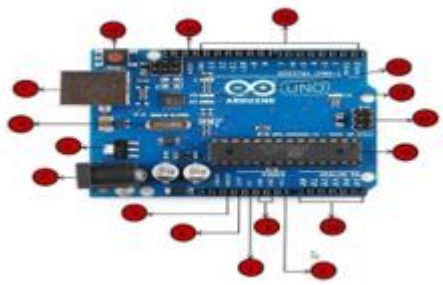

Table 3.3 Board types

1	**Power USB** Arduino board can be powered by using the USB cable from your computer. All you need to do isconnect the USB cable to the USB connection (1).
2	**Power (Barrel Jack)** Arduino boards can be powered directly from the AC mains power supply by connecting it to theBarrel Jack (2).
3	**Voltage Regulator** The function of the voltage regulator is to control the voltage given to the Arduino board andstabilize the DC voltages used by the processor and other elements.
4	**Crystal Oscillator** The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time?The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz.
5, 17	**Arduino Reset** You can reset your Arduino board, i.e., start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, you can connectan external reset button to the Arduino pin labelled RESET (5).

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6, 7, 8, 9	**Pins (3.3, 5, GND, Vin)** • 3.3V (6) − Supply 3.3 output volt • 5V (7) − Supply 5 output volt • Most of the components used with Arduino board works fine with 3.3 volt and 5 volt. • GND (8)(Ground) − There are several GND pins on the Arduino, any of which can beused to ground your circuit. • Vin (9) − This pin also can be used to power the Arduino board from an external powersource, like AC mains power supply.
10	**Analog pins** The Arduino UNO board has six analog input pins A0 through A5. These pins can read the signalfrom an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

4. SOFTWARE EXPLINATION

4.1 MC PROGRAMMING LANGUAGE: EMBEDDED C -

This is the most widely used programming language for embedded processors/controllers. Assembly is also used but mainly to implement those portions of the code where very high timing accuracy, code size efficiency, etc. are prime requirements. Embedded C is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems. There are many popular programming languages like Assembly, BASIC, C++ etc. that are often used for developing Embedded Systems but Embedded C remains popular due to its efficiency, less development time and portability.

4.2 PROTEUS:

Proteus is a simulation and design software tool developed by Lab centre Electronics for Electrical and Electronic circuit design. It also possesses 2D CAD drawing feature. It deserves to bear the tagline “From concept to completion”.

4.3 ABOUT PROTEUS:

It is a software suite containing schematic, simulation as well as PCB designing. ISIS is the software used to draw schematics and simulate the circuits in real time. The simulation allows human access during run time, thus providing real time simulation.

ARES is used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components.

The designer can also develop 2D drawings for the product.

4.4 FEATURES:

ISIS has wide range of components in its library. It has sources, signal generators, measurement and analysis tools like oscilloscope, voltmeter, ammeter etc., probes for real time monitoring of the parameters of the circuit, switches, displays, loads like motors and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semi-conductor switches, relays, microcontrollers, processors, sensors etc.

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ARES offers PCB designing up to 14 inner layers, with surface mount and through hole packages. It is embedded with the foot prints of different category of components like ICs, transistors, headers, connectors and other discrete components. It offers Auto routing and manual routing options to the PCB Designer. The schematic drawn in the ISIS can be directly transferred ARES.

4.5 STARTING NEW DESIGN

Step 1: Open ISIS software and select New design in File menu

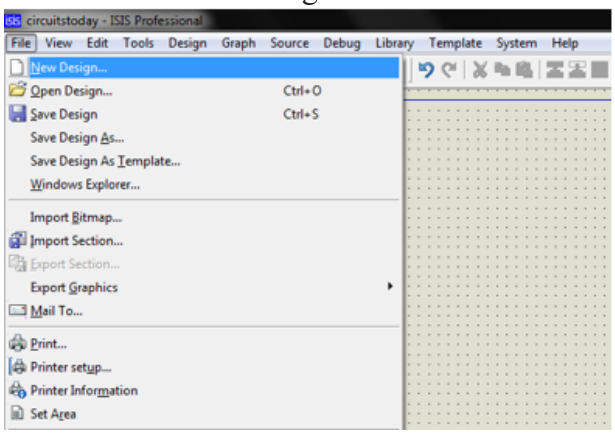

Figure 4.1: Proteus File Menu

Step 2: A dialogue box appears to save the current design. However, we are creating a new design file so you can click Yes or No depending on the content of the present file. Then a Pop-Up appears asking to select the template. It is similar to selecting the paper size while printing. For now, select default or according to the layout size of the circuit.

Step 3: An untitled design sheet will be opened, save it according to your wish, it is better to create a new folder for every layout as it generates other files supporting your design. However, it is not mandatory.

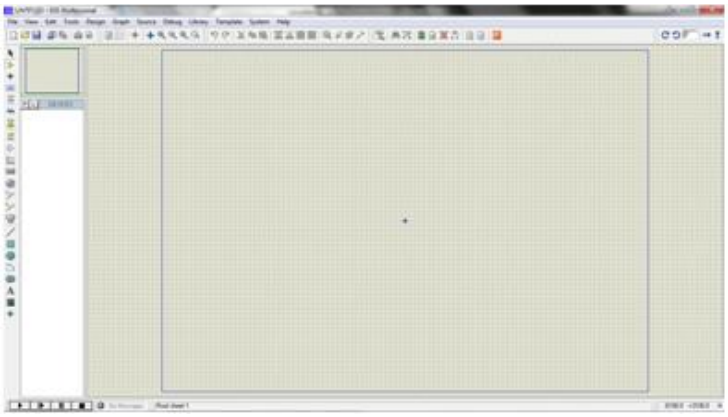

Figure 4.2 Proteus Design Sheet

Step 4: To Select components, Click on the component mode button.

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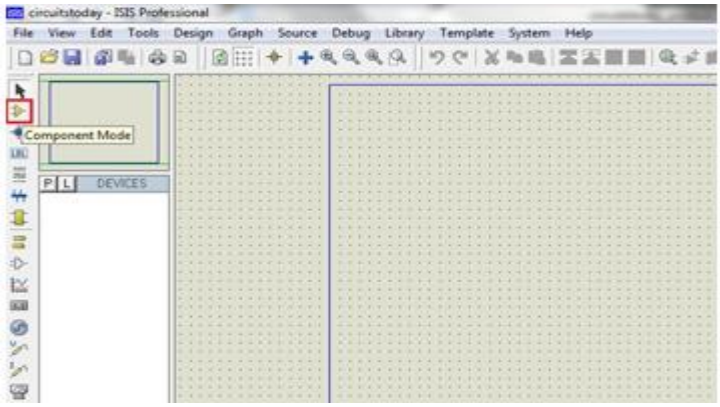

Figure 4.3 Component Mode

Step 5: Click on Pick from Libraries. It shows the categories of components available and a search option to enter the part name.

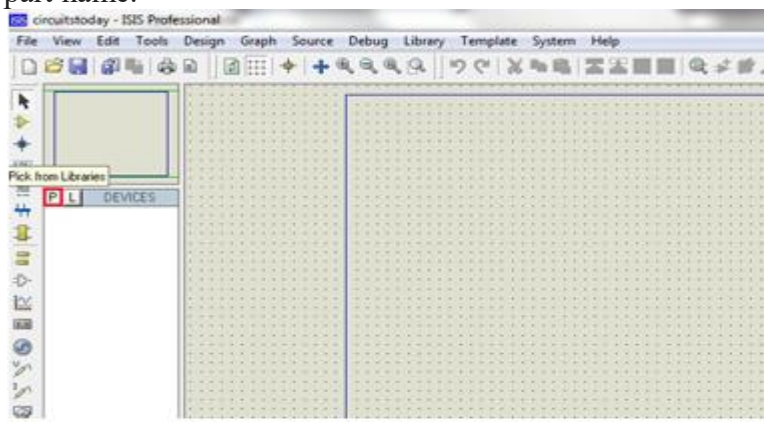

Figure 4.4: Pick from Libraries

5. ADVANTAGES AND APPLICATIONS

ADVANTAGES:

- Real-time monitoring.
- Remote Accessibility
- Scalability
- Centralized Data Storage and Processing
- Collaborative and Cooperative Analysis
- Continuous Improvement
- Cost-Effectiveness
- Data security and privacy

APPLICATIONS:

- Health and fitness monitoring
- Sports Performance Analysis
- Elderly care and fall detection
- Workplace safety
- Security and Surveillance
- Gesture recognition and human-computer interaction

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6. RESULT

Figure 6.1 Result

Figure 6.2 Output

7. CONCLUSION

A need for real-time health and activity recognition with wearable sensors is a prerequisite for assistive paradigms. This paper presents a brief overview of existing health and behaviour-monitoring approaches based on wearable IoT technologies. Secondly, it illustrates a novel health monitoring system framework WISE, which enables the real-time monitoring of the patients or elderly users and allows the information to be accessed from the cloud.

FUTURE SCOPE

The future of smart wearable technology is mostly linked with interconnectivity among devices and the ability to sync data between wearables and mobile phones. Energy harvesting is another big domain, and it pertains to converting body heat, movement or solar energy into power. Innovative companies like Epeas are working on ambient energy harvesting, processing and sensing solutions in order to make wireless devices that do not need to be actively charged. Another innovation that Facebook is working on is non-invasive sensors that will allow hands- free typing using your brain activity.

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