International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 13 Issue: 05 | May 2026 www.irjet.net p-ISSN: 2395-0072

SMART HEALTH AND KNOWLEDGE BASED TRACKING AND INTERVENTION WEARABLE FOR SAFETY EMERGENCY CARE

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Abstract-*S.H.A.K.T.I. is an IoT based wearable device made to help with personal safety, how we monitor our health. The system constantly tracks key physiological signs like heart rate, SpO_2 level and temperature using on-board sensors and embedded technology. The device will provide immediate emergency assistance with both automatic aberration detection and a panic button. In case of an emergency, the system will send a SMS with the GPS co-ordinates of the user to pre-defined contacts via either GSM or Wi-Fi communication modules. The Arduino ATmega328P microcontroller will process all of the sensor data and control all of the device's operations. The device also has a 16×2 LCD display that shows the user real-time health data and an emergency status. The S.H.A.K.T.I. device is compact, portable, energy efficient and easy to use for everyday life. The device will work to provide safety for women, elderly people and remote healthcare monitoring. Between testing and evaluation, reliable communication, effective emergency alerting capabilities and accurate health monitoring were confirmed. The S.H.A.K.T.I. device provides a very low-cost and practical solution to the integration of personal safety and health monitoring into a single smart wearable device.*

Keywords-Women Safety, IoT Wearable Device, Health Monitoring, Emergency Alert System, Arduino, GPS Tracking, SpO_2 Monitoring, Embedded Systems.

INTRODUCTION

As a result of increasing worries regarding the safety of females and the requirement to monitor their health continuously, there is now a demand for wearable emergency systems. The traditional methods to ensure safety rely on the use of smartphones or manual communication or GPS locations, all of which may fail due to the nature of panic, accidents, and medical emergencies. The proposed project, titled S.H.A.K.T.I (Smart Health and Knowledge-based Tracking & Intervention Wearable for Safety Emergency Care), has been created as a means of providing IoT-based emergency safety and health monitoring capabilities to individuals via wearable devices. The System will monitor vital physiological parameters such as heart rate, SpO_2, and body temperature using various sensors that are interfaced with a microcontroller, specifically, the Arduino ATmega328P. In the instance of an emergency, the device will automatically detect an abnormal situation or can have an alert triggered manually by pressing a panic button. The system will also utilize GPS and GSM/Wi-Fi modules to send emergency notifications and the individual's real-time location to pre-defined contacts. This wearable device is expected to have a compact, portable, low-cost, and easy-to-use profile and will provide an effective solution for providing women safety, elderly monitoring, and healthcare assistance by means of embedded and IoT technologies.

I. LITERATURE SURVEY

Many researchers are working on making systems that people can wear to monitor their health and also on ways to keep women safe using the Internet of Things and special tiny computers.

A. Systems to Keep Women Safe Using the Internet of Things

People have done a lot of studies on systems that help women in emergency situations. These systems use phone and Internet of Things technology together in one device. The main goal of these devices is to help women get help from people to them or from the police when they are in trouble. These devices usually have a panic button, a way to communicate and a way to track where the woman is.

B. Wearable Systems to Monitor Health

There are devices that people can wear to monitor their health. These devices use tools like heart rate monitors, oxygen level monitors and temperature sensors to check how the body is doing. More and more people in the healthcare community are using these devices. They help collect health information and send it to doctors or nurses.

C. Special Tiny Computers Used in Healthcare

Tiny computers like Arduino are being used more and more in healthcare. They are popular because they are cheap do not use a lot of energy and are easy to carry around. They are also simple to connect to devices to collect information, from sensors process the information and make decisions right away. Woman's safety systems and wearable health monitoring systems are using these tiny computers to help people.

II. METHODOLOGY

A fresh approach links body-worn sensors with smart hardware, sending data through airwaves to trigger fast help via internet-connected devices.

3.1 System Architecture: Inside the S.H.H.A.K.T.I setup lives several key parts: Health Monitoring Sensors, Microcontroller Unit, Communication Module, GPS Tracking Module, Emergency Alert Mechanism, LCD Display Unit. From the sensors, raw body signals flow nonstop into the setup. Into an Arduino ATmega328P chip they go, where changes happen in real time.

3.2 Health Monitoring Mechanism:

- Health Monitoring System: heart rate oxygen levels monitored, Glow from the sensor eases beneath your skin, bounces off blood just underneath. When the heart pushes, that rebounded shine wavers a touch, showing every thump. Red cells grab more or less light based on oxygen, their grip changing with each breath. Rather than tracking beats by hand, the gadget follows small jumps in brightness as seconds pass. Bouncing higher means more oxygen inside. When it slows, something shifts below the surface. Signals return, tracing how breath moves through veins. Each shift tells a quiet story of balance. The Heart Rate and SpO_2 Monitoring Sensors Operate Without Interruption. Beyond every single pulse count lies what the heart is doing. A share of oxygen in circulation comes through as SpO_2 values. Out of nowhere, the numbers might jump - could be pressure rising, perhaps fear taking hold, possibly a warning that demands quick attention. When things reach a limit, the body sometimes reacts with sharp changes on screen.

- Body Temperature Measuring: A tiny sensor watches body heat all day long. From it, signals travel - some waves, some bits - to a compact box close by. If values climb or drop beyond normal, trouble could be starting within. The earliest hint of fever appears right in those changes, ahead of coughs or chills. Hidden dangers sometimes reveal themselves only through such silent jumps or dips.

3.3 Emergency Detection Mechanism:

When needed, it can spot emergencies by itself or let someone step in to report one.

- Manual Emergency Activation: Should things turn dangerous, a dedicated button lets users call for help right away. One press sends out an urgent signal without delay. When feeling threatened, this feature activates instantly. It works whenever someone needs immediate assistance.
- Automatic Emergency Detection: Every second, the tiny computer checks readings from sensors. When it spots something off - like odd body signals - it takes note. Strange heart rhythms? It sees them. Breathing trouble showing up? That gets flagged too. Heart racing out of nowhere. Oxygen levels dipping below normal range. Temperature acting strange without warning. After that, emergency mode kicks in by itself.

3.4 GPS Location Tracking:

Out in the open, the NEO-6M GPS chip catches signals from space. When trouble hits, position details ride along with the distress signal sent out.

3.5 Wireless Communication

Wireless signals travel through the air when an ESP8266 chip joins the network. Instead of wires, a GSM unit sends data step by step. Information moves out once the system links up. Transmission begins only after connection locks in place. When something goes wrong, a warning shows up right away. If your body changes in some way, that detail gets recorded here. Where you are at any moment stays tracked through satellite signals. Messages go out to set contacts or services stored online.

3.6 Display Unit

On screen, sixteen characters fit each of two lines. What happens shows up right away here Heart Rate SpO_2 Level. Body Temperature. GPS Coordinates Emergency Status

3.7 Software Implementation

Programming happens through the Arduino IDE; a tool built for working with microcontrollers in Embedded C. This environment handles code writing, plus it prepares programs for upload. Running tests comes next, followed by sending the finished code to the device. Each step fits together without extra tools getting involved. From sensors, data gets collected step by step. After that, signals go through filtering and refinement. When levels cross a set point, alerts begin forming. If danger shows up clearly, the system flags it fast. Messages then move out based on priority rules. At the same time, screen updates happen smoothly

A. Block Diagram

In S.H.A.K.T.I. model the oxygen sensor passes a small beam of light slips through the skin, measuring oxygen in blood - this sensor spots breathing issues before they grow. Not a single snapshot, but constant updates reveal shifts almost as they happen. Every pulse gets counted by another unit, focused only on heartbeat over time. When pressure jumps or surprise hits, that number holds

answers. Rhythm wobbles? That quiet change may whisper what the body feels inside. Heat from the body gets caught by one small part - it tracks how warm things stay moment to moment. If temperatures climb past normal or dip without warning, signals wake up deep in the system. Every piece works on its own, yet stays ready to link when signs point toward danger. A hidden web hums under fabric, alert but silent, speaking only when something shifts wrong. Trouble triggers fast: hit the red switch, and help alerts fire off instantly, no waiting. The PIC16F628 chip runs everything inside - reading data from sensors, processing it, after that deciding what actions follow.

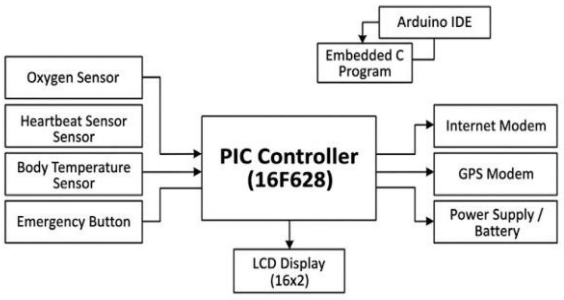


Fig.3.1 Block Diagram

What happens shows up right away on the 16×2 LCD: current body readings appear, plus any warning status stays visible. Instead of cables, an Internet Modum or Wi-Fi piece sends alerts and key numbers through online gadgets straight to family members nearby. At the very same time, the GPS Modem locks onto location details, sending fresh position marks once trouble begins so rescuers reach faster. Energy moves out from either the main power source or a backup battery, feeding each section without pause even during travel. Code in C brings sensor links, emergency alerts, and data moves together under one roof. Built into the setup, Arduino helps write programs, spot issues, correct errors, then shift them smoothly to the core chip - keeping things running steady.

WI-FI Module:

ESP8266 Description:

Inside the S.H.A.K.T.I wearable, designed for emergency health tracking, sits a tiny but vital part - the ESP8266 Wi-Fi chip. Though built cheap and kept small, it links machines to the web, especially those tied into smart networks. Espressif Systems made this piece; it runs full network protocols while packing its own processor inside. Because everything fits on one-unit, extra gear isn't needed just to go wireless. Tiny in form, yet strong in function, it draws little energy while staying reliable under load. Now found nearly everywhere, from sensors to gadgets, it powers countless connected tools quietly behind the scenes.

Inside the S.H.H.A.K.T.I setup, wireless signals travel thanks to the ESP8266 chip - its core job. Health signs like heartbeat, blood oxygen (SpO_2), and heat of the skin get watched nonstop via small sensors tied to a tiny computer brain. If something looks off - or if fingers tap the panic switch - the moment triggers an online message blast. Messages fly out across networks carrying warnings plus vital stats meant for set phone numbers or emails. Help arrives faster because people who care can see trouble start before it grows worse. Alerts arrive fast, cutting wait times just when seconds matter most.

Wi-Fi on the ESP8266 follows older formats like 802.11 b/g/n, so linking up to home routers feels smooth. Talking between this chip and something like an Arduino happens through UART - simple wiring, steady data flow. Running only on 3.3 volts, it sips energy instead of draining it, perfect when batteries must last weeks. Inside its tiny frame hides storage space plus brainpower enough to juggle signals without help. Tasks pile up quietly; still, it handles each one without slowing down.

What makes the ESP8266 stand out in the S.H.A.K.T.I setup is how it works with IoT tools. Because it connects to IoT networks, live health updates and urgent warnings reach cloud services, phone apps, or distant tracking units. Monitoring stays active wherever there's an internet connection. Later improvements could include saving data online, linking deeper into smartphone software, using artificial intelligence to study wellness patterns, even triggering intelligent rescue responses when needed.

Most of the time, the ESP8266 boosts how well the emergency alerts work. When danger hits, it fires off updates - health info tagged with exact position - without needing a phone at all. Because of this, help arrives faster, giving people a better shot at quick care. It talks to several gadgets and online hubs at once, so fitting into today's smart device networks feels natural.

Most folks like the ESP8266 because it doesn't cost much and takes up little space. Built small and light, it links without hassle to screens, sensors, or tiny computers - this smooths out building wearables. Because it's cheap, putting together full S.H.A.K.T.I units stays affordable. That opens doors for wider adoption, especially where money matters, like health tracking or safety gear.

Because of its small shape, the ESP8266 helps the S.H.A.K.T.I device send data without wires. This chip links the gadget to internet networks so it can share updates from far away. When urgent signals need sending, it handles those quickly. Speed matters here - yet it uses very little energy. Built tough, it runs steadily even under stress. For health tracking gear meant for personal protection, that reliability becomes

key. Size also helps - it fits neatly inside wearable designs without adding bulk.

Fig. 3.2 WI-FI Module (ESP8266)

Microcontroller (ATMEGA328P):

Inside many gadgets, robots, and smart tools sits the ATmega328P - a compact 8-bit chip made by Microchip Technology. Found often in learning kits and DIY electronics thanks to its straightforward layout, minimal energy needs, and user-friendly coding setup. This tiny processor drives the well-known Arduino Uno, fueling its appeal across classrooms, workshops, and engineering desks. Instead of complex logic, it handles tasks like watching sensor signals, crunching numbers, then adjusting lights, speakers, machines, or screens accordingly.

Running as fast as 20 million cycles each second, this tiny computer holds 32 thousand bytes of program space. Inside lives 2 kilobytes of short-term memory where info rests while active. Stored separately, one full kilobyte keeps data safe even when power drops away. Twenty-eight contact points stretch out from its body - some watch voltage levels, others catch digital signals. Through these openings, it links directly to lights, buttons, temperature chips, and more. Talking between gadgets happens smoothly thanks to build in rules for signal exchange: UART leads here, SPI moves bits rapidly, I2C uses just two lines. Coders shape its behavior either by writing close to metal instructions or typing inside a friendly visual workspace meant for newcomers. Learning how things work feels less steep because tools fit human thinking.
The ATmega328P stands out how little power it uses while still delivering steady results. Running on batteries isn't a problem, opening doors for mobile setups and internet-connected gadgets. Think along the lines of automated homes, tools that sense nearby objects, gear tracking weather changes, personal safety tech for women, or general control circuits. Small in form, light on budget, simple to connect - these traits keep the chip a frequent pick across embedded design and electronic builds.

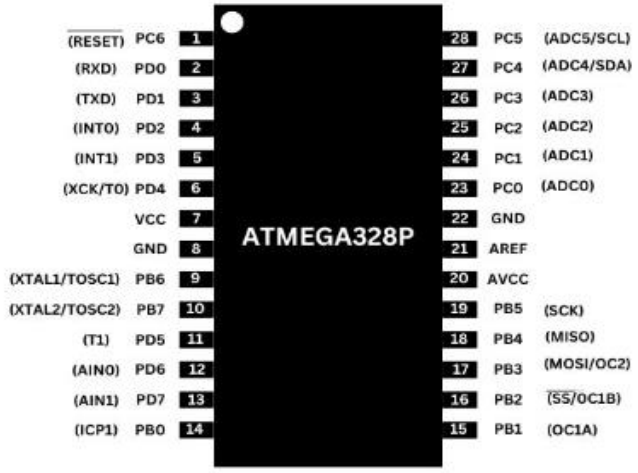
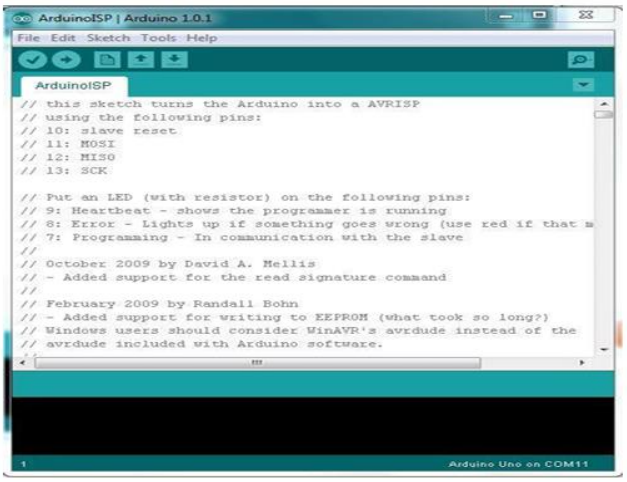


Fig.3.3 ATMEGA328P

Arduino IDE Compiler:

The Arduino IDE Compiler Module is the part of the Arduino software that transforms a user-programmed sketch (an Arduino program) into something that the Arduino will understand and execute once it's compiled. An example is an Arduino program written in C/C++ basic programming language. The Arduino compiler will produce machine code by going through an analysis of the program code to check for error conditions prior to sending the code to the Arduino microcontroller to execute it.
Steps:
1. A sketch (the name of an Arduino program) is constructed by the user in the Arduino IDE.
2. The user clicks on the Verify button (✓).
3. The compiler analyzes the code for missing statements and syntax errors.
4. The compiler will convert the code into machine code.
5. The compiler will link all necessary files and libraries together for execution.
6. Then clicks on Upload button (→).
7. Then code will be sent to the Arduino.
8. Finally, the Arduino microcontroller will execute the code.

The main functions of the Compiler Module are:
*Conversion of Source Code to Machine Code
*Basic Programming Error Detection
*Links Required Libraries
*Completes and Produces an Executable File (HEX)
*Upload the Compiled Code to the Arduino Board



III. CONCLUSION AND FUTURE SCOPE

The S.H.A.K.T.I wearable system is an integrated system of embedded systems, communication technology (IoT), and disposable medical device technologies to provide safety and emergency services while enhancing individual health. The wearable will continuously monitor several vital parameters, such as heart rate, blood oxygenation level, and body temperature, while simultaneously providing emergency alerts. In addition, built-in GPS and wireless communication will facilitate fast access to emergency services and allowing for the monitoring of users from a distance. S.H.A.K.T.I will be a small, light-weight, low cost, portable and user-friendly device suited for applications in women's safety, senior citizen monitoring, and health care support systems.

Future Scope:

- Integration into cloud-based health monitoring systems.
- Dedicated mobile applications.
- AI predictions of future emergency events and health analysis of users.
- Addition of ECG monitoring, blood pressure monitoring.
- Improved battery management and energy efficiency.
- Miniaturization of the S.H.A.K.T.I device.

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