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Research Paper

Home monitoring system based on wireless sensor networks to monitor the health of the elderly

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ABSTRACT: *Wireless-sensor-network-based domestic checking framework for elderly action behavior includes a utilitarian appraisal of everyday exercises. In this paper, we detailed an instrument for the estimation of elderly well-being conditions based on the utilization of household machines associated with different detecting units. We characterized two modern wellness capacities to decide the status of the elderly on performing fundamental day-by-day exercises. The created framework for checking and assessing basic everyday exercises was tried at the homes of four diverse elderly people living alone and the results are empowering in deciding the wellness of the elderly.*

KEYWORDS- *Activities of daily living, Eldercare, Home monitoring, Smart home, Wellness, Wireless sensor network.*

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I. INTRODUCTION

An ordinary individual performs day-by-day exercises at customary intervals of time. This infers that the individual is rationally and physically fit and driving a standard life. This tells us that the general well-being of the individual is at a certain standard. If there's a decline or alteration within the customary action, then the wellness of the individual isn't within the typical state. Elderly individuals crave to lead a free way of life, but in the ancient age, individuals gotten to be inclined to distinctive mischances, so living alone has tall dangers and is repetitive. A developing sum of inquiries is detailed in later times on the improvement of a framework to screen the exercises of an elderly individual living alone so that offer assistance can be given time recently any unanticipated circumstance happens.

Within the show work, a cleverly domestic observing framework based on ZigBee remote sensors has been planned and created to screen and assess the well-being of the elderly living alone in a domestic environment [1]. The wellness of the elderly can be assessed for estimating hazardous circumstances amid checking of customary exercises. The created framework is cleverly, strong and does not utilize any camera or vision sensors because it barges in security. Based on a study among the elderly we find that it incorporates tremendous adequacy to be utilized at home due to nonuse of the camera or vision-based sensors[2,3].

The brilliant software, along with the electronic framework, can screen the utilization of diverse family apparatuses and recognize the exercises to decide the well-being of the elderly. Too, the framework translates all the fundamental elderly exercises such as planning breakfast/lunch/dinner, showering, restroom utilization, dining, resting, and self-prepping. Fundamentally, the framework works based on the utilization of information on electrical and non-electrical machines inside a domestic.

The framework has been created to be used in an existing domestic involving an elderly or maybe in a test bed situation or for a recently built house[4]. At the hardware level, remote sensors arranged with ZigBee components are associated with the shape of the work topology, and a central facilitator of the sensing units collects information from the sensors associated with different machines.

The created computer code ceaselessly peruses the information from the facilitator and proficiently stores it on the framework for further information preparation in genuine time. The information preparation includes steps for wellness checks based on the information of day-by-day exercises performed in conjunction with the utilization of household machines, for predicting change within the day-by-day action design of the framework.

In this system, a required number of sensors for checking the day-by-day exercises of the elderly have been utilized[5]. Increment in the number of sensors increments the fetched of the framework and may to complicate the establishment. An assortment of frameworks for observing and utilitarian evaluation for elderly care have been proposed and created in later times. Checking exercises of the individual based on camera-based sensors are detailed and the pictures of the individual are taken and analyzed[6].

Genuine home applications such as reconnaissance and security make full utilize of camera-based systems but for domestic observing exercises it needs a gigantic adequacy among the elderly. Other than the camera, infrared-based Little Movement Locators (SMDs), passing sensors, operation locators and IR movement sensors have been joined within the house for checking the human activity conduct, and the elucidation of human action is limited to as it were to some human exercises.

There are several ventures accessible on wearable health devices personal wellness monitoring and security coordinates with sensors to give nonstop monitoring of a person's wellbeing-related issues and action observing[7]. Moreover, frameworks utilizing RFID communication innovation in the senior center were presented. Even though these gadgets are for particular purposes, they have extreme concerns related to security, protection, and legitimate perspectives. Ordinarily, individuals are hesitant to wear a framework persistently on their bodies. So, it may not be a reasonable choice for sound elderly individuals. This circumstance may be worthy of a persistent recovery.

In case numerous sensors can be introduced for the screen of all machines utilized by the elderly in a recently constructed house, it gives fundamental information for elderly checking. This may not be conceivable in most down-to-earth situations as the elderly as a rule live in their homes, which were built, amid their youthful age. Subsequently, the elderly houses are fundamentally ancient and existing. Frameworks like further human checking utilizing wireless sensor systems were presented in later times. Computer program systems with distinctive machine learning techniques are joined into the remote frameworks[8].

Also, checking and modeling of elderly exercises of everyday living were incorporated. Though technology is successfully executed, these frameworks are restricted to a few activities. There's a gigantic request for an electronic framework with clever instruments, moo taken a toll, adaptable, simple to introduce, vigorous, and precise for observing fundamental Exercises of Day-to-day Living (ADLs) of elderly living alone so that offer assistance can be provided at the correct time[9].

The ultimate objective of individual wellness frameworks is to supply care for elderly individuals at the right time no matter where they live, but innovation seems to help with moves from one level of care to the following and offer assistance to anticipate untimely arrangements in expensive assistance spaces. Movement acknowledgment and Wellness assurance are two imperative capacities to be worn out in an opportune way or maybe offline. Subsequently, real-time preparation of information is a must for recognizing action conduct and predicting irregular circumstances of the elderly.

To bargain with issues such as checking the day-by-day exercises, execution following of normal conduct, and well-being of the elderly living alone a framework that is noninvasive, adaptable, low-cost, and secure to utilize is designed and developed. An initial decline or alteration in normal exercises can be identified by the home checking system and trigger messages to the suitable care supplier almost the changes within the utilitarian capacities of the elderly individual.

II. METHODOLOGY

2.1 TRANSMITTER:

When transmitting data using an antenna, a transmitter is an electronic device used in telecommunications that generates radio waves. By applying a radio frequency alternating current to the antenna, which radiates it as radio waves, the transmitter can produce radio waves.

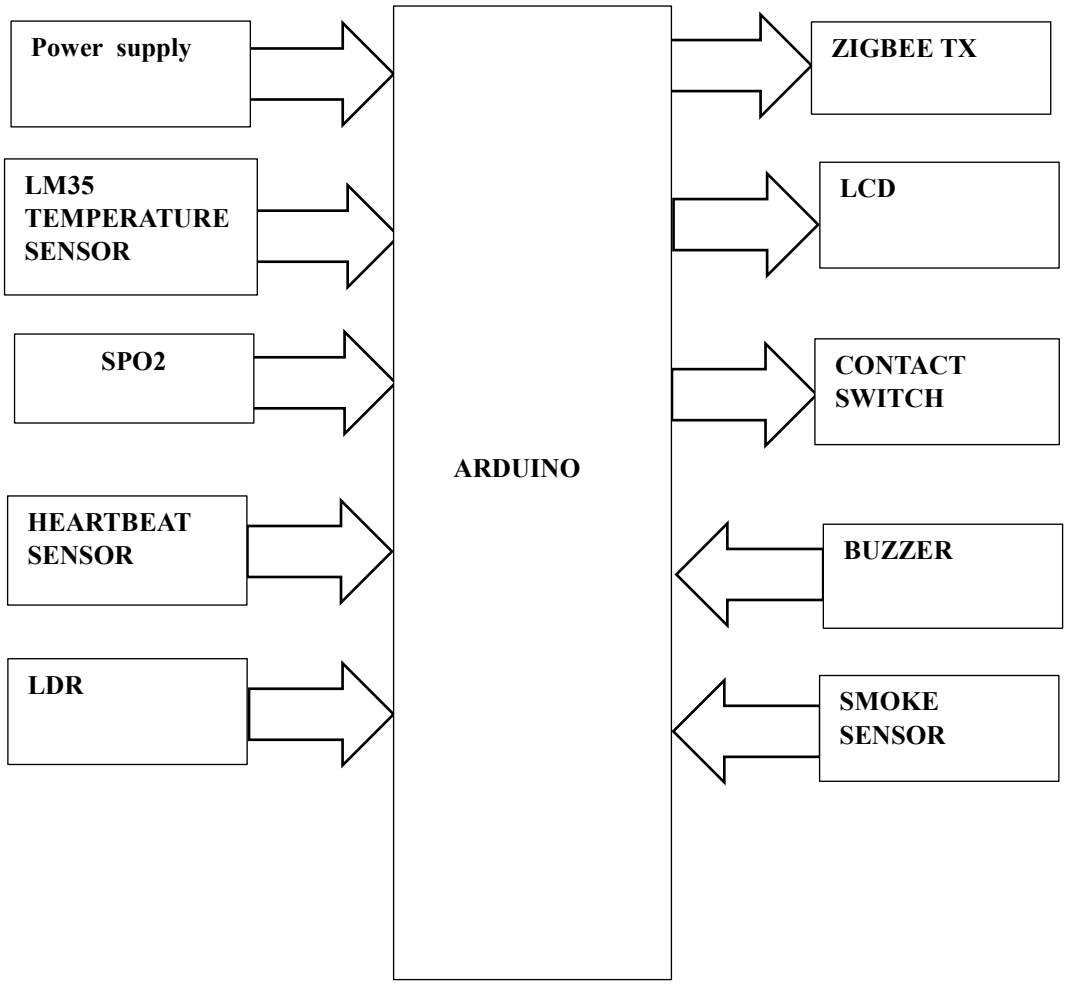

FIG:2.1 TRANSMITTER BLOCKDIAGRAM

RECEIVER:

This is a component of the phone device that is housed in the earpiece and uses sound-generating electrical signals.

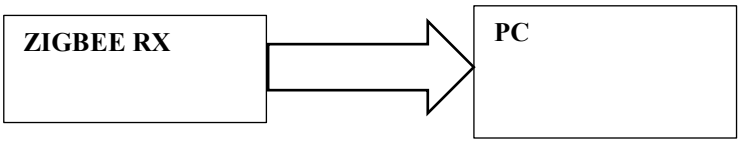

FIG:2.2 RECEIVER BLOCK DIAGRAM

III. SYSTEM DESCRIPTION

3.1 Arduino Uno:

A microcontroller board built on the ATmega328 platform is called the Arduino Uno (datasheet). It features six analog inputs, a 16 MHz crystal oscillator, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; all you need to do is power it with an AC-to-DC adapter or battery to get going or connect it to a computer using a USB cable. Unlike all previous boards, the Uno doesn't make use of the FTDIUSB-to-serial driver chip. Instead, it has an Atmega8U2 that has been configured to function as a serial-to-USB converter.

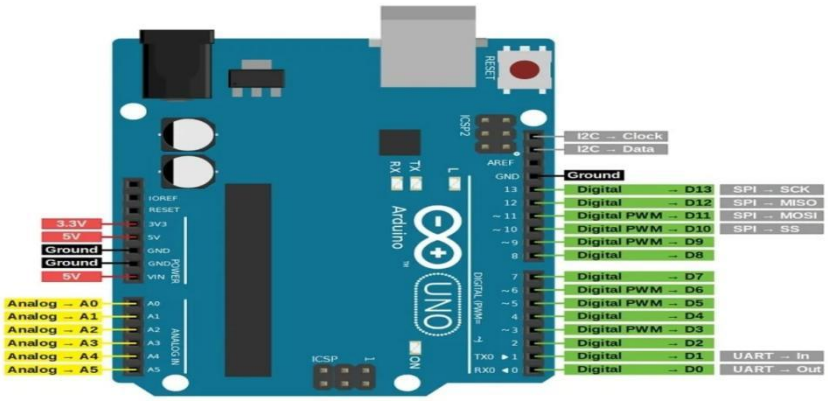

FIG:3.1: Arduino Uno

3.2 Zigbee modules:

As developed the system is composed of two fundamental parts. At the lowest level, a wireless sensor network that is integrated with Zigbee modules in a mesh structure is in place. It gathers sensor data depending on how household appliances are used and saves it in a computer system for later analysis. Low-level information is all that is contained in the collected sensor data, which merely includes the sensor's name and its active or inactive condition. The low-level module has several sensors that are connected to identify when beds, chairs, and electrical equipment are being used. It also has a panic button.

3.3 Power supply unit:

A source of electrical power is referred to as a power supply. PSUs, or power supply units, are systems or devices that provide electrical or other forms of energy to a set of loads or an output load.

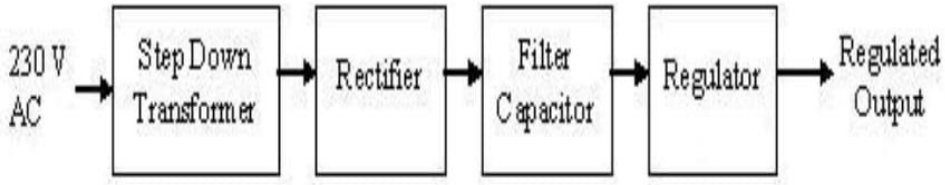

FIG:3.2: power supply unit

3.4 Step-down Transformer:

Two windings, referred to as primary and secondary coils, make up a transformer. Inductively coupled electrical conductors, or CORE, are connected. The secondary coil experiences an alternating voltage as a result of a shift in the magnetic field in the core brought on by a change in the primary current. A current that alternates will flow through the load if a load is applied to the secondary. A perfect situation would see the magnetic field transmit all of the energy from the primary circuit to the secondary circuit.

$$P_{rimary} = S_{econdary}$$

So

$$I_pV_p = I_sV_s \quad (1)$$

$$\frac{V_S}{V_P} = \frac{N_S}{N_P} \quad (2)$$

3.5 Bridge Rectifier:

As the name suggests, it converts the full wave, i.e., both the positive and negative half cycles, into DC, making it much more efficient than a half-wave rectifier, and that too without using a center-tapped transformer, making it much more cost-effective than a full-wave rectifier. The Full Bridge Wave Rectifier consists of four diodes, namely D1, D2, D3, and D4. During the positive half cycle, diodes D1 and D4 conduct, whereas in the negative half cycle, diodes D2 and D3 conduct. As a result, the diodes continuously flip the transformer connections, giving us an output with positive half cycles.

3.6 Filter Capacitor:

While both half-wave and full-wave rectifiers produce DC output, none of them offer a steady output voltage. We must smooth the waveform that the rectifier sent us to achieve this. A capacitor known as a "filter capacitor," "smoothing capacitor," or "reservoir capacitor" can be used to achieve this at the rectifier's output. There will still be some ripple even after using this capacitor.

3.7 Voltage Regulator:

An apparatus that transforms a variable input voltage into a steady, controlled output voltage is called a voltage regulator.

3.8 Temperature Sensor -LM35:

Temperature sensors are a straightforward device that translates a degree of heat or coldness into a readable unit. The output voltage of the precision integrated-circuit temperature sensors in the LM35 sensor series is linearly proportional to the temperature in Celsius (Centigrade).

3.9 Smoke Sensor- MQ6:

Gases such as butane and LPG can be detected or measured by the MQ-6 smoke sensor. When attempting to identify a single gas, the digital pin included with the MQ-6 sensor module allows the sensor to function even in the absence of a microcontroller. The analog pin, which is TTL-driven and operates on 5V, must be used to measure the gas in parts per million. As a result, it can be utilized with the majority of microcontrollers.

3.10 SPO2 Sensor:

The MAX30100 is a sensor package that combines a pulse oximeter and a heart rate monitor. The optical sensor measures the absorbance of pulsing blood using a photodetector after two LEDs, one each for red and infrared light, emitting two different wavelengths of light.

3.11 LDR:

The terms photoresistor, photocell, and photoconductor are other terms for an LDR or light-dependent resistor.

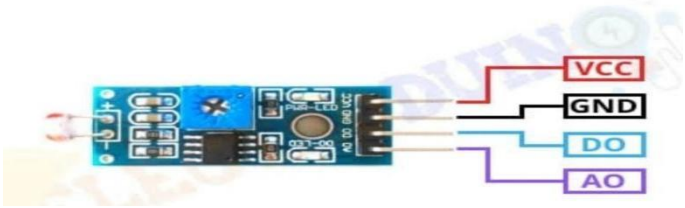

FIG 3.3: LDR

It is one kind of resistor and the resistance changes in response to the quantity of light that strikes its surface. The resistance of the resistor varies when light strikes it. In many circuits where detecting the presence of light is necessary, these resistors are frequently utilized. These resistors come in a variety of resistances and applications.

3.12 Contact switch:

Any mechanism that brings two conductors into controlled contact with one another can be used to build a switch. This can be as easy as pressing two metal strips into contact or just letting two copper wires come into contact with one another by using a lever. On the other hand, a well-designed switch must be sturdy, dependable, and prevent the operator from receiving an electric shock. Consequently, this level of clumsiness is uncommon in industrial switch designs. Contacts are the conductive components of a switch that are used to establish and terminate an electrical connection.

3.13 Buzzer:

A mechanical, electromechanical, or electrical buzzer or beeper is an aural signaling device. Buzzers and beepers are commonly utilized for alarms, timers, and verifying user input, such as mouse clicks or keystrokes.

3.14 Heart Beat Sensor:

When a finger is inserted into this heartbeat sensor, it is intended to produce a digital readout of the heartbeat.The topmost LED flashes in time with each heartbeat when the heart detector is functioning. To measure the rate in beats per minute (BPM) this digital output can be directly connected to a microcontroller. It operates on the theory that each pulse in the finger causes a change in light.

3.15 LCD:

Input and output devices that speak with people directly must be used by software to communicate with the outside world. An LCD is one of the most commonly connected devices to a controller. 16X1, 16x2, and 20x2

LCDs are a few of the most often used LCDs that are linked to the controllers. This translates to 16 characters on a single line. There are sixteen and twenty characters per line by two lines, respectively.

III. RESULTS AND DISCUSSION

This is how the experiment is set up: To monitor the behavior of the elderly and assist those who live alone if they exhibit any unusual behavior at any given time, a WSN that includes six electrical sensors, four force sensors, two contact switch sensors, one combined temperature/humidity monitoring sensor, one alarm/reset button, and two contact switch sensors is installed in the home. A laptop running specifically created intelligent software and coupled to a coordinator Zigbee module is connected to the wireless sensor network to collect and monitor the behavior of the elderly. Programs for data collection, activity recognition, and wellness assessment are written using Microsoft Visual Studio.

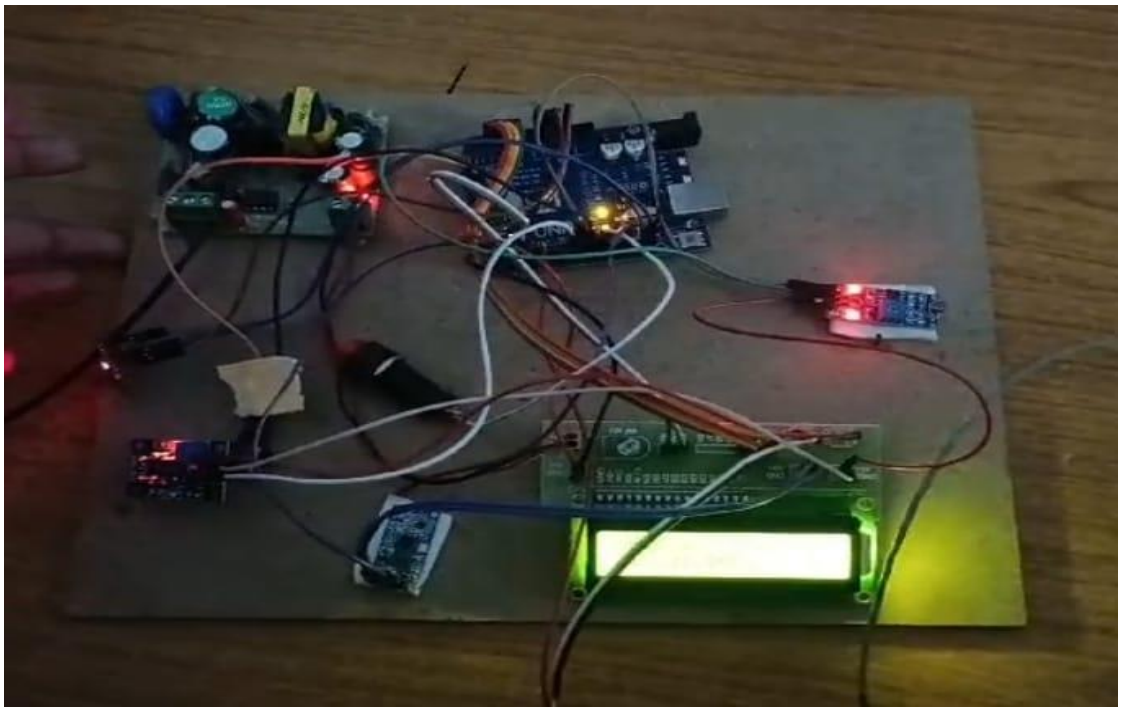

FIG 4.1: Kit diagram of Home monitoring system based on wireless sensor networks to monitor the health of the elderly

The constructed sensing modules and Zigbee components are set up in a mesh topology to facilitate efficient communication with the Zigbee coordinator and enable the system to record sensor readings for further machine-learning operations. A presentation of the obtained results brings this section to a close. Easily viewed on the system's front end is the elderly's current activity status. With the use of this interface, a caregiver can quickly ascertain the current level of activity of an older person.

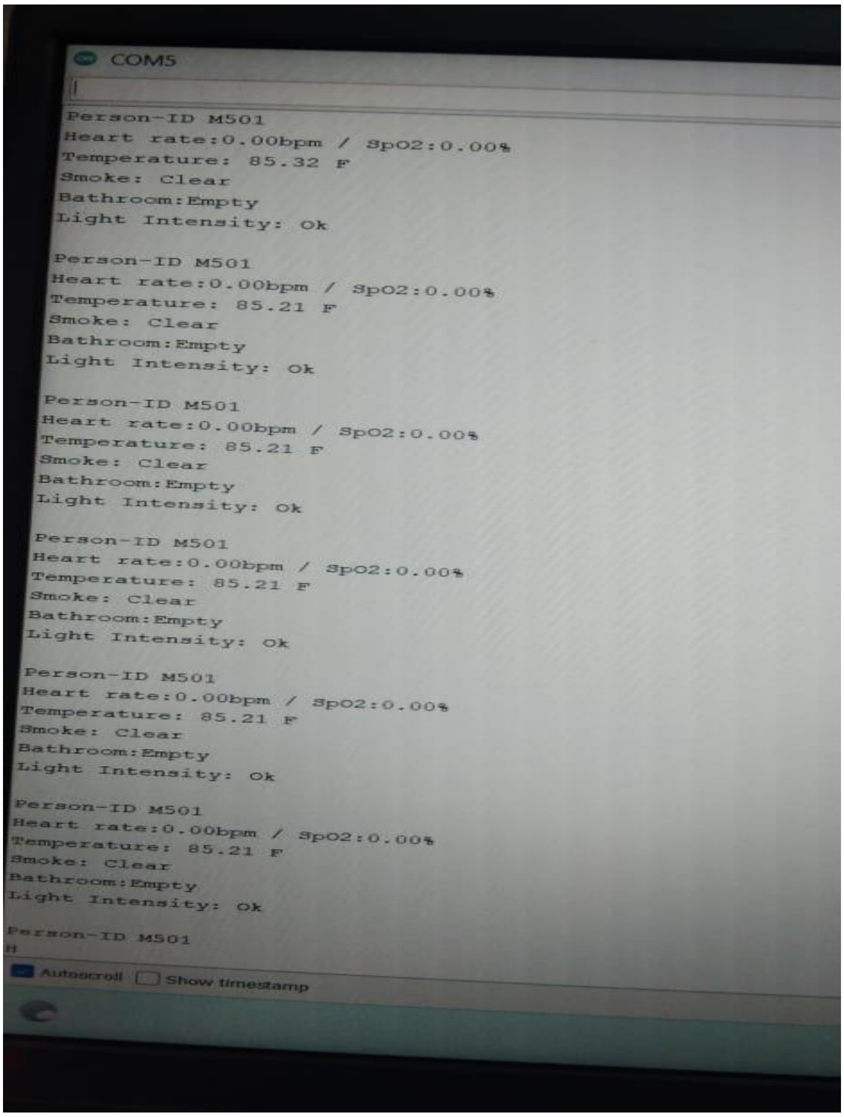

FIG 4.2: Output in Aurdino IDE software using Arduino Uno board

Additionally, the system can analyze wellness indices and record sensor activity data simultaneously. One further benefit of the interface is that it makes it simple to monitor elderly people remotely. The status of real-time sensor activity at each hour of the day is concurrently stored in the computer's relevant files for data processing. For efficient data processing, the computer records the state of continuous sensor activity in the corresponding files. Wellness features were useful in determining which appliances and how much of them the elderly used at home. These are also useful in foretelling the early aberrant state in which older adults do ADLs.

IV. CONCLUSION

Well-being is a broad and complex concept. In this study, "wellness" refers to an elderly person's ability to carry out everyday tasks at home with efficiency. This will make it easier for the caregivers to evaluate how well the elderly are performing their activities. The home monitoring system that makes use of WSN is affordable, reliable, adaptable, and effective at monitoring and evaluating the actions of the elderly in real-time at home.

The system demonstrated stability in carrying out the tasks for a few weeks, which made it encouraging to identify the elderly's real-time activity behavior and determine their health function through the use of appliances. The best possible usage of the appliances used by the elderly will be determined if the system is run for the necessary number of months. Additionally, the effectiveness of wellness features in anticipating the unusual behavior of senior citizens when utilizing common household equipment will rise. The sub-system for monitoring physiological parameters will soon be added to the system. The information concerning health metrics such as body temperature, heart rate, and so on will be supplemented by this, allowing daily activity

behavior recognition and elderly health perception to be evaluated in tandem to ascertain the elderly's overall wellness.

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