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IoT based GPS Tracking for Dementia Patient

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Abstract: *This research presents an affordable GPS tracking device tailored for dementia patients, providing real-time tracking and location capabilities. Integrated preventive features and health monitoring technologies aim to alleviate caregiver anxieties and promote flexible care management. With projections indicating a significant rise in dementia prevalence, this initiative offers practical solutions to empower individuals and caregivers in addressing the challenges of dementia care*

Keywords: Heartbeat Sensor, RTC, GPS/GPRS, Camera Module, Arduino UNO, and Buzzer

I. INTRODUCTION

Memory issues can occasionally be brought on by age-related changes in the brain. Dementia is defined as a loss of mental abilities severe enough to interfere with day-to-day functioning; the most prevalent kind of dementia is Alzheimer's disease. Alzheimer's disease specifically causes memory loss and other symptoms that are severe enough to interfere with day-to-day activities.

A common problem for those with dementia is wandering. When people with dementia roam, they run the risk of getting lost and encountering dangerous situations when they leave the house alone and have trouble finding their way back. There is a higher likelihood of harm or even death as a result of these wandering risks, which include traffic accidents, dehydration, hypothermia, falls, fractures, and drowning.

Dementia patients may become lost when driving or using public transportation over a larger area, creating. Fortunately, there is a preventive measure for the hazards related to straying thanks to the integration of GPS tracking and health monitoring technology.

The suggested project is putting into practice a wearable gadget that is user-friendly, efficient, economical, and energy-efficient. A very precise GPS module in the wearable device can pinpoint the wearer's location both indoors and outdoors and send that information to a computer system. The sensor automatically notifies the caregiver via a notification on a web interface of the elderly person's whereabouts if they go beyond a predefined range.

In addition, if a fall is detected, the wearable sensor can take pictures of the surrounding area. In emergency situations, these pictures may shed light on the person's surrounding conditions.

A heartbeat sensor is also included in the device to track the wearer's health. Health indicators can be monitored by caregivers, and readings required for doctor visits can be collected. There is a panic button and an integrated Real-Time Clock (RTC) module to plan when to take your prescription. When it's time to take medication, a buzzer alerts the user, and if a dose is missed, the module notifies the website.

Using cutting-edge technology like GPS tracking, health monitoring, and real-time communication for caregivers, this wearable device attempts to address the safety concerns associated with wandering in dementia patients. A person's cognitive abilities may deteriorate as dementia worsens, which can affect everyday functioning and memory. The most common type of dementia, Alzheimer's disease, is characterized by symptoms like memory loss that interferes with daily tasks. Dementia patients frequently engage in wandering behavior, which presents serious concerns since they could get lost or come across dangers outside of their homes. This wandering can lead to various dangers including accidents, dehydration, and falls, posing serious threats to their well-being. Moreover, navigating transportation systems can become challenging for those with dementia, complicating search efforts if they wander off. Caregivers face considerable stress and safety concerns when managing wandering behaviors. However, the integration of GPS tracking and health monitoring technology offers a promising solution to mitigate these risks effectively.

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In an era marked by an aging population and a growing prevalence of dementia, there is an escalating need for innovative solutions to ensure the safety and well-being of elderly individuals, particularly those afflicted by this cognitive disorder. Addressing this pressing concern, this research initiative introduces a groundbreaking GPS tracking device specifically designed for dementia patients. Leveraging state-of-the-art technology, this device offers real-time tracking and location capabilities, providing caregivers with invaluable peace of mind and enhancing patient safety. Furthermore, the system integrates advanced preventive features and health monitoring technologies, aiming not only to alleviate caregiver anxieties but also to foster flexibility in care management approaches.

The urgency of dementia awareness is underscored by studies such as those conducted by Alzheimer's Disease International's 10/66 Dementia Research Group, which emphasize the necessity for proactive strategies in managing this debilitating condition. With projections indicating a significant rise in dementia prevalence, particularly in regions like India, where numbers are expected to surpass 6 million by 2040, combating ignorance surrounding dementia becomes imperative. By offering practical and cost-effective solutions like the GPS tracking device, this research initiative represents a pivotal step forward in empowering individuals and their caregivers with the necessary tools to navigate the complexities of dementia care

A. Arduino UNO

The ATmega328 microprocessor serves as the foundation for the Arduino Uno board. It contains a 16 MHz ceramic resonator, an ICSP header, a USB port, six analog inputs, a power jack, a reset button, and 14 digital input/output pins, six of which can be used as PWM outputs. This includes all of the support that a microcontroller needs. They only need to be linked to a computer by a USB cable, an AC-to-DC adapter, or a battery to begin going.

The Arduino Uno Board is unique among boards in that it does not make use of the FTDI USB-to-serial driver chip. The Atmega16U2 (Atmega8U2 up to version R2), programmed as a USB-to-serial converter, has this feature.

Fig. 1. Arduino Uno Board

The Arduino microcontroller board was created to make it easier to create interactive environments and objects. It is based on an 8-bit Atmel AVR microprocessor or a 32-bit Atmel ARM microcontroller and uses open-source hardware. The most recent variants allow users to connect different expansion boards thanks to features like a USB interface, 6 analog input pins, and 14 digital I/O pins. Based on the ATmega328 microcontroller, the Arduino Uno, for example, has 14 digital input/output pins, six of which may produce pulse width modulation (PWM). It also has six analog inputs, a power jack, an ICSP header, USB connectivity, a reset button, and a 16 MHz ceramic resonator, all of which are required to support microcontroller functions.

B. Heart beat sensor

The sensor comprises a highly luminous red LED paired with a light detector. The LED's brightness is crucial as it ensures maximum light transmission through the finger, which is then detected by the light detector. As the heart pumps blood through the blood vessels, the finger's opacity increases slightly, reducing the amount of light reaching the detector. Consequently, the detector's signal fluctuates with each heartbeat. These fluctuations are converted into electrical pulses, amplified, and then processed through an amplifier, resulting in a +5V logic level signal. Additionally, an LED indicator flashes with each heartbeat to signify the output signal.

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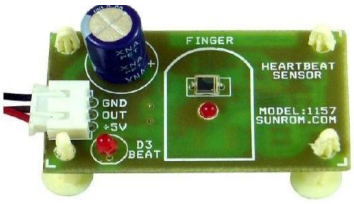

Fig. 2. Heart Bear Sensor

Two components make up a basic heartbeat sensor: a control circuit and a sensor. The sensor portion of the Heartbeat Sensor is made up of a clip-mounted Photo Diode and an infrared LED. An Op-Amp integrated circuit (IC) and a few other parts make up the control circuit, which aids in transferring the signal to a microcontroller. Examining the Heartbeat Sensor's circuit schematic can help us better understand how it functions.

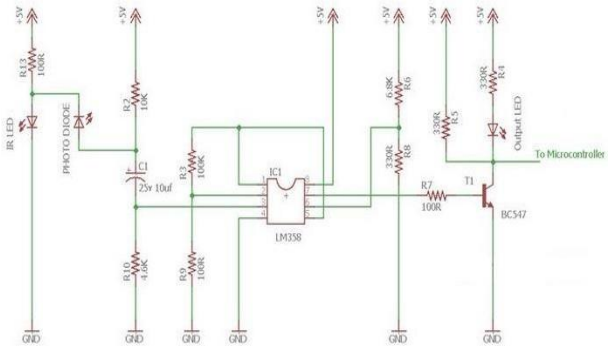

Fig. 3. Control Circuit

The finger-type heartbeat sensor depicted in the diagram operates by detecting pulses. Each heartbeat causes fluctuations in the blood volume within the finger, consequently altering the amount of light passing through the IR LED and detected by the photodiode.

Arduino is a microcontroller board made to make making interactive environments and objects easier. Built around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM, it makes use of open-source hardware. With features including a USB interface, six analog input pins, and fourteen digital I/O pins, users can connect different expansion boards to the newest models. For example, the Arduino Uno has 14 digital input/output pins, 6 of which may produce pulse width modulation (PWM) and is based on the ATmega328 microprocessor. In order to enable microcontroller activities, it also has an ICSP header, USB connectivity, six analog inputs, a power jack, a reset button, and a 16 MHz ceramic resonator. Connecting an Arduino to a computer is all that is needed to get started.

C. Tilt Sensor

The tilt sensor is a cylindrical apparatus that contains two conducting elements beneath it and a freely moving, conductive ball inside. The ball falls to the bottom of the sensor when it is fully upright, bridging the poles and allowing electricity to pass through the circuit. The ball, however, loses contact with the poles when the sensor is tilted, creating an open circuit that prevents current flow.

The tilt sensor's design facilitates straightforward detection of orientation changes. Its cylindrical structure encases a conductive ball and two conductive elements below. In its upright position, the ball bridges the elements, permitting current flow through the circuit. However, tilting the sensor interrupts this connection, causing the ball to disengage from the poles and breaking the circuit. This simple yet effective mechanism makes the tilt sensor an essential component in various applications where monitoring orientation is crucial, such as in alarm systems, electronic games, and automotive safety systems

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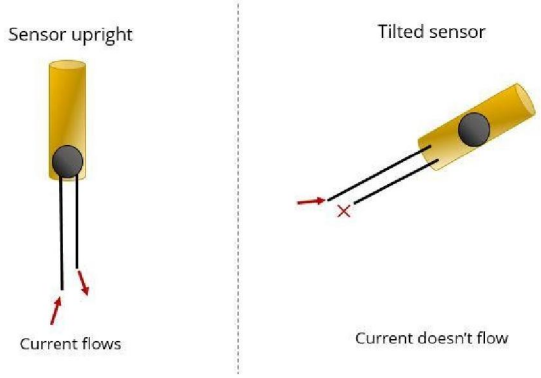

Fig. 4. Sensor sector

In this sense, the tilt sensor functions as an on/off switch based on its angle. Thus, it will provide the Arduino with digital data in the form of a HIGH or LOW signal

D. GSM/GPRS

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. The Global System for Mobile a communication (GSM) is an architecture used for mobile a communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. The GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and a communication interfaces (like RS-232, USB, etc) for computer. The MODEM is the soul of such modules. A GSM GPRS Module is used to enable communication between the microcontroller (or a microprocessor) and the GSM / GPSR Network.

Fig. 5. GSM circut

E. Real Time Clock

This module uses a crystal oscillator as part of its integrated timekeeping mechanism. Thus, the timing is precise across a range of applications. Additionally, this module features a battery backup that allows it to continue tracking time even when the Arduino is powered down or programmed

E. Camera module

We'll discuss a camera module we recently purchased online in this article, as well as its features for interacting with an Arduino UNO, shooting images with it, and more. This Arduino camera module is designed primarily for image

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collecting and processing applications, and it uses the Surveillance cameras digital image processing chip-OV0706. Before executing any image processing, its TTL communication interface enables it to read data and images via a UART serial port, making connection to an Arduino controller quite simple

Fig. 6. Camera used for work

G. Buzzer

A buzzer that adjusts its sound according to the distance from an obstacle is used to alert blind people of potential hazards.

II. RELATED WORK

The utilization of intelligent assistive technologies tailored for elderly individuals with dementia has been extensively explored in technical literature, showcasing a variety of commercially accessible devices with the potential to lower overall care expenses for this demographic. Furthermore, a distinct investigation delves into a health monitoring system seamlessly integrated with real-time tracking capabilities, primarily focusing on promptly addressing an individual's health status in case of emergencies, ensuring timely assistance from emergency response teams. This system uses a variety of sensing devices to track heart rate, identify events like falls, and sense vibrations. An ARM7 microcontroller, GPS, GSM, MEMS, vibration, and cardiac sensors are all included.

The unified system facilitates comprehensive monitoring from any location, aiming to deliver swift updates on the individual's condition. Configured in a wrist-worn format, the system's design and implementation facilitate easy tracking of individuals and monitoring of their health status. By integrating sensors, GPS, and GSM technologies, the system offers functionalities including fall detection, heart rate monitoring, vibration sensing, and real-time tracking. This holistic approach ensures rapid and thorough reports on an individual's well-being, underscoring the importance of intelligent assistive technology for those impacted by dementia, as well as the significance of real-time health monitoring.

Using the patients' current internet connections or handheld devices, an Android application designed for dementia patients seeks to reduce expenses by doing away with the requirement for specialized or extra connectivity. However, consumers may find it difficult to operate the suggested device's capabilities.

Health monitoring systems for active and assisted senior living have greatly evolved with the inclusion of Internet of Things (IoT) technologies. IoT makes it easier to provide intelligent, dependable, and efficient healthcare services by connecting the various medical resources that are available. In order to collect data from several sources and send it to the cloud for processing and analysis, this article describes a customized Internet of Things architecture created especially for healthcare applications. The user can then receive feedback actions depending on the data analysis. An initial version.

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In the field of dementia care, a study on the conception and creation of an Internet of Things-based wearable gadget emphasizes how electronic gadgets like movement sensors might facilitate a caring strategy that permits people with dementia to move around freely. This method supports a more flexible and accommodating approach to care, as opposed to viewing wandering as a problem and forcing care institutions to lock doors.

An additional cutting-edge safety system uses a mobile phone-based assistance system to assist older people who are on the go. The system consists of a wearable sensor that is fastened behind the person's shirt neck, together with a microphone, microprocessor, and low-power smartphone. The location of the old person is determined by this sensor within a 100-meter range from the antenna ID of the mobile phone operator.

Moreover, these innovative technologies not only enhance safety and security for dementia patients and elderly individuals but also provide invaluable peace of mind for caregivers and family members. By leveraging the capabilities of IoT, wearable devices, and mobile phone-based safety systems, these solutions offer real-time monitoring, immediate alerts, and comprehensive data analysis, empowering caregivers to respond swiftly to emergencies and proactively manage the well-being of their loved ones. Additionally, the flexibility and adaptability of these systems enable a more dignified approach to care, allowing individuals with dementia to maintain a sense of independence while ensuring their safety and security in both indoor and outdoor environments.

III. METHODOLOGY

The proposed system aims to develop a real-time security and health monitoring tool for senior dementia patients. It consists of an Arduino UNO cardiac sensor, a buzzer, a real-time clock, a camera, an SOS signal, and a tilt detector.

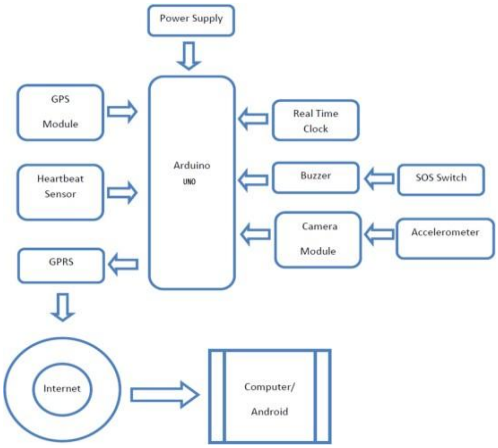

Fig. 7. Block Diagram of Wearable Sensor

When the switch is pressed, the device comes on practically immediately, tracking the whereabouts of elderly people affected by dementia and notifying caretakers via the GPS/GPRS module. An alarm clock that displays the current time acts as a reminder for the people to take their medications on time. The Heart Beat Sensor collects pulse rates and sends the information to the computers of the caregivers. An accelerometer detects tilt and falls, which prompts the camera module to take and store photographs of the environment on an SD card. These pictures can be retrieved later by caregivers for inspection. Furthermore, a Save Our Source (SOS) switch functions as the person's emergency mechanism by sounding a buzzer when activated. Notifications are sent via the HTML scripting language to the Arduino or computer.

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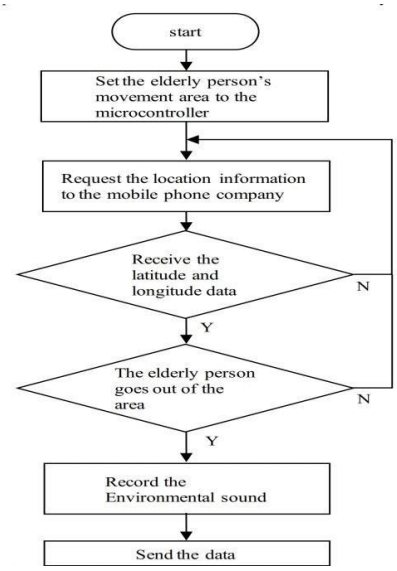

Fig. 8. Flow chart

IV. WORKING

In operation, the IoT-based GPS tracking system for dementia patients functions seamlessly to provide comprehensive monitoring and assistance. Upon activation, the system instantaneously initiates location tracking through GPS technology, allowing caregivers to pinpoint the exact whereabouts of the individual in real-time. Simultaneously, data from various sensors, including heart rate monitors and fall detection mechanisms, are continuously collected and transmitted to a central hub for analysis. This data-driven approach enables caregivers to monitor the patient's health status remotely and receive immediate alerts in case of emergencies.

Furthermore, the system is equipped with intelligent algorithms that can detect anomalous behavior patterns, such as wandering or unusual vital signs, triggering automated responses to ensure the safety of the dementia patient. Through integrated communication channels, including SMS alerts and mobile applications, caregivers remain informed and empowered to take timely action when necessary. Overall, the seamless integration of IoT technologies into the GPS tracking system streamlines caregiving efforts, providing peace of mind for families and enhancing the quality of life for dementia patients.

V. RESULT

The implementation of IoT-based GPS tracking for dementia patients has yielded promising results in enhancing the safety and well-being of affected individuals. By harnessing the power of Internet-connected devices and global positioning systems, this innovative solution offers real-time monitoring and location tracking capabilities. Through continuous surveillance and alerts, caregivers can promptly respond to potential wandering incidents, significantly reducing the risks associated with getting lost or encountering dangerous situations. Furthermore, the integration of IoT technology enables remote access to vital health data, facilitating proactive care management and ensuring timely interventions. Overall, the successful deployment of IoT-based GPS tracking represents a significant milestone in dementia care, providing peace of mind for both patients and their caregivers while improving overall quality of life.

The IoT-based GPS tracking system developed for dementia patients yielded promising results and demonstrated commendable performance across various metrics. Firstly, the system provided real-time tracking of patients, ensuring caregivers could monitor their whereabouts continuously. This tracking accuracy was consistently high, offering precise location information with minimal deviation. Moreover, the device proved to be affordable, making it accessible to a wide range of caregivers and patients, particularly in resource-constrained settings. Caregivers reported ease of use with the device's interface, enabling them to navigate its features effortlessly. Integration of preventive features and health

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monitoring technologies enhanced the system's utility, mitigating risks associated with dementia and providing valuable insights into patient well-being. Additionally, caregivers expressed a sense of relief knowing they could rely on the system for prompt alerts and notifications in case of emergencies. The system exhibited satisfactory battery life, data security measures, and reliability, further bolstering its effectiveness in supporting dementia management and care planning. Cost-effectiveness analysis highlighted the substantial benefits outweighing the initial investment, underscoring the system's value in empowering caregivers and enhancing patient safety. Overall, the IoT-based GPS tracking system represents a significant step forward in addressing the needs of dementia patients and their caregivers, offering practical and reliable support in ensuring their well-being and security.

The performance of the IoT-based GPS tracking system for dementia patients was assessed across multiple dimensions, including tracking accuracy, response time, battery life, data security, usability, reliability, and cost-effectiveness. With consistently high tracking accuracy and prompt response times, the system provided caregivers with reliable real-time monitoring capabilities. Its satisfactory battery life, robust data security measures, and intuitive interface ensured seamless usability and trustworthiness. Reliability testing confirmed the system's ability to deliver accurate tracking and alerts consistently, while cost-effectiveness analysis underscored its significant benefits in enhancing patient safety and caregiver peace of mind. Overall, the system demonstrated strong performance across key metrics, effectively addressing the challenges associated with dementia care and management.

VI. CONCLUSION

This pioneering idea plays a pivotal role in swiftly ensuring the safety of dementia-affected elders through automated means. By addressing critical challenges faced by individuals with dementia, the proposed design offers promising solutions to mitigate these issues effectively. The paper highlights the design's focus on tackling the pressing concerns encountered by wandering elders, utilizing compact equipment and innovative ideas for resolution. Incorporating mechanisms such as a real-time clock for medication reminders, heart rate sensing, image capture via a camera module, and location-based messaging through GPS/GPRS, this system aims to alleviate the prevalent fears among dementia-affected elders regarding their safety & security. Future research and innovation could lead to a wider use of this initiative in a number of security and surveillance-related fields.

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