IoT Based Smart Alarm Clock

Someshwar Karmakar
Department of Electronics & Communication Engineering
Chandigarh University
Mohali, Punjab
20BEC1112@cuchd.in

Abhishek Khare
Department of Electronics & Communication Engineering
Chandigarh University
Mohali, Punjab
20BEC1104@cuchd.in

Kushal Jain
Department of Electronics & Communication Engineering
Chandigarh University
Mohali, Punjab
20BEC1110@cuchd.in

Priyanshu Singh
Department of Electronics & Communication Engineering
Chandigarh University
Mohali, Punjab
20BEC1096@cuchd.in

Harshit Gaurav
Department of Electronics & Communication Engineering
Chandigarh University
Mohali, Punjab
20BEC1150@cuchd.in

Dr. Harmeet Singh
Department of Electronics & Communication Engineering
Chandigarh University
Mohali, Punjab
harmeetsingh.ece@cumail.in

***Abstract*—In the era of advanced connectivity, this paper introduces an innovative IoT-based Smart Alarm Clock, leveraging the ESP8266 for a compact yet powerful computing experience. Unlike traditional alarm clocks, this smart device offers customizable wake-up alerts with preferred sounds and stands out through its internet integration via Wi-Fi, ensuring real-time updates and accurate time synchronization. A dedicated mobile app provides convenient control, allowing users to receive personalized messages and manage settings effortlessly. Going beyond the basics, the smart alarm clock incorporates environmental awareness by offering insights into room temperature and humidity levels. It further features interactivity, responding to user queries and engaging in dynamic conversations. This paper seamlessly combines conventional alarm clock functionality with cutting-edge smart technology, delivering a device that not only wakes users up but also enhances their mornings. With smartphone compatibility, the IoT-based Smart Alarm Clock ensures a user-friendly and accessible experience, positioning itself not just as a timekeeping device but as a comprehensive solution for intelligent and convenient mornings.**

Keywords— IoT, Wi-Fi, Clock, ESP8266.

I. INTRODUCTION

In the realm of technological innovation, our ambitious paper focuses on developing a highly sophisticated Smart Alarm Clock, seamlessly integrated with the ESP32 computer to harness the vast capabilities of internet connectivity. This groundbreaking alarm clock seeks to revolutionize the traditional waking-up experience. At its core, the intelligent timekeeping device features impeccable time precision, the ability to set multiple alarms with diverse sound options, and a convenient snooze function catering to individual user preferences. Internet connectivity ensures precise time synchronization and enhances functionality, positioning the Smart Alarm Clock as a multifaceted device addressing various user needs.

A pivotal aspect of the paper is the emphasis on user-friendly design and seamless interaction. Meticulously crafted, the Smart Alarm Clock offers users a convenient and intuitive experience, enabling effortless navigation of its features. Smartphone control adds an extra layer of accessibility, reflecting the paper's commitment to integrating modern technological conveniences into users' daily lives.

The Smart Alarm Clock extends its capabilities beyond timekeeping by incorporating advanced environmental monitoring features. Users gain real-time insights into temperature and humidity levels, contributing to a more comfortable living environment and aligning with the trend of smart homes that intelligently respond to and enhance living spaces. This environmental monitoring feature positions the Smart Alarm Clock as a holistic device, addressing temporal needs and contributing to user well-being and comfort.

An innovative facet of the Smart Alarm Clock lies in its interactive functionality. Users can engage in conversations with the device, transforming the waking-up routine into a personalized and interactive experience. This conversational feature extends beyond conventional alarm clock capabilities, allowing users to inquire about weather updates, receive news reports, and establish a dynamic rapport with the device for an informed and engaging start to the day.

In essence, our paper represents a comprehensive endeavour to simplify and enhance the waking-up process. Combining state-of-the-art technology, user-friendly design, and multifunctional features, the Smart Alarm Clock transcends conventional boundaries, emerging as a pivotal element in the integration of smart devices into daily routines. As we navigate the ever-evolving landscape of technological advancements, the Smart Alarm Clock stands as a testament to the potential of IoT-driven innovations to seamlessly integrate into and elevate our daily lives.

II. LITERATURE REVIEW

The application of low-cost System on a Chip (SoC) boards in do-it-yourself (DIY) Internet of Things (IoT) projects, with a focus on an intelligent alarm clock. The objective is to demonstrate how affordable SoC boards, particularly the ESP32 and Raspberry Pi, can empower the DIY IoT community in advancing smart object innovation. The proposed smart alarm clock integrates data from web services related to traffic, weather, and local temperature sensors to determine an optimal alarm time for users. The study evaluates existing IoT components, state-of-the-art alarm clocks, and presents a comprehensive account of the hardware and software components used in the intelligent alarm clock's design. It emphasizes user feedback, considerations for further enhancement, and the motivations behind engaging in DIY activities. The research also discusses the broader context of IoT, smart objects, and their communication capabilities. The study underscores the advantages of incorporating SoC boards for IoT innovation, addressing computational feasibility and power consumption concerns. Additionally, it highlights potential improvements, such as expanding sensor communication via wireless networks and utilizing dedicated gateways for enhanced efficiency and security. The research concludes by emphasizing the documented and accessible nature of the components used, promoting mass innovation potential in the

DIY IoT field **[1]**. This research focuses on the hardware design and implementation of an intelligent alarm clock using the Arduino platform. The innovative alarm clock utilizes a passive infrared sensor (PIR) to identify various sleep states, including Hypnagogia, NREM, REM, Hypnexagogium, and dreaming. The primary objective is to optimize the alarm time for users in a state of wakefulness or light sleep, enhancing the waking experience. The hardware components include an LCD LED display, a real-time clock (RTC) unit, a temperature and humidity sensor, a photosensitive module for daytime detection, a touch sensor, and a WiFi module for time synchronization. The study provides insights into sleep phases, emphasizing the alternating cycles of NREM and REM, and introduces the unique states of Hypnagogia and Hypnexagogium. While various smart solutions exist for sleep cycle facilitation, this project stands out by focusing on sleep phase detection using Arduino, distinguishing itself from typical alarm clock applications. The functional prototype demonstrated successful detection of the "almost awake" moment during sleep, with the PIR sensor proving more precise than accelerometers in mobile devices. The study concludes with considerations on the subjective nature of exact precision in alarm activation and highlights positive user ratings for applications of this nature found on platforms like Google Play **[2]**.

The research introduces a novel exploration into smart alarm clocks by integrating IoT technology, aiming to surpass conventional functionality with real-time synchronization and customizable alarms. The architectural blueprint involves a sophisticated synergy of sensors, actuators, and a central control unit, providing not only alarm-setting capabilities but also a personalized user interface for easy configuration. However, the paper is critiqued for its limited exploration of connectivity options, overlooking vital aspects such as user privacy, power optimization, and network security. The absence of a comparative analysis with traditional alarm clocks is noted, and the paper's credibility could be enhanced with real-world user testing, feedback, discussions on scalability, and practical application considerations. Despite these gaps, the paper sets the stage for an IoT-driven evolution of alarm clocks, emphasizing customization and connectivity in unexplored ways, calling for future research to address identified shortcomings **[3]**.

Introduction of the innovative AlarmX smart alarm system, aiming to revolutionize morning wake-up experiences through a seamless and energizing approach. Combining mobile app technology with Arduino automation, the system orchestrates a gradual wake-up process, featuring ascending alarm tones, progressive room lighting, and automation of tasks like fan control and water heater activation. What distinguishes this system is its incorporation of a cognitive challenge, requiring users to solve a mathematical calculation to turn off the alarm, aiming to stimulate and prepare them for the day ahead. The system ensures a smooth transition of control from Arduino to the main power supply post-wake-up. Positioned as a space-efficient alternative to mobile phones, the smart alarm system not only saves time but also promotes an active and alert start to the day. By leveraging technology and automation, it advances the traditional concept of alarms, addressing the need for timely awakenings in a fast-paced society. AlarmX, the team behind this innovation, envisions exciting possibilities for the future, including expanding services to iOS and Windows users, monitoring sleep cycles, and introducing features to encourage healthier sleep and exercise routines. In conclusion, AlarmX emerges as a promising contributor to transforming morning routines, prioritizing user experience and overall well-being through technology for more productive and energetic mornings **[4]**.

The focus of this research paper introduces the Smart Alarm Clock, a cutting-edge innovation that integrates modern technological advancements with traditional wake-up methods. Distinguished by its ability to tailor wake-up times to individual sleep patterns and preferences, the smart alarm utilizes a range of sensors, including motion, light, and sound sensors, for precise data analysis. The architecture involves seamless integration of these sensors into the hardware, complemented by a sophisticated algorithm on the software side. This algorithm processes data to calculate the optimal wake-up time based on the user's specific sleep patterns, significantly enhancing the quality of sleep and streamlining morning routines. Despite its advantages, challenges include the need for accurate data analysis, fine-tuning the algorithm for diverse sleep patterns, and addressing ethical considerations related to data privacy. The future prospects include integration with smart home systems and the potential incorporation of machine learning and AI to further refine personalized wake-up solutions. In conclusion, the Smart Alarm Clock presents a significant advancement in wake-up technology, offering a personalized and data-driven approach with the potential to reshape morning routines through continuous advancements and integration with emerging technologies **[5]**.

The literature review explores the transformative impact of the Internet of Things (IoT) on security and surveillance systems, emphasizing the need for advanced measures in an increasingly automated world. Traditional security systems relying on motion sensors face limitations in distinguishing between authorized and unauthorized individuals, prompting the evolution towards IoT-based solutions. Notable advancements include the integration of ultrasonic sensors for enhanced intrusion detection, facial recognition for reliable authentication, remote camera surveillance for real-time monitoring, and power failure detection to address traditional system vulnerabilities. While these innovations promise comprehensive security, challenges such as privacy concerns with facial recognition, cybersecurity risks, and implementation costs persist. The proposed IoT-based smart security and surveillance system seeks to overcome these challenges by incorporating a range of features, providing a flexible and scalable solution for various property types. The literature review underscores the evolution from conventional security approaches to IoT-based solutions, emphasizing the imperative to balance security, privacy, and cost-effectiveness for widespread adoption across diverse settings **[6]**. The paper introduces iWakeUp, an intelligent alarm system designed for sleep status assessment and wake-up time optimization within a smart living environment. The system incorporates a non-invasive data collection and processing module installed in the bedroom to monitor sleep patterns. The paper details iWakeUp's structure, including the methodology for motion measurement, the process of inferring wake/sleep status from video data, and the algorithm for determining the optimal wake-up time. Noteworthy is the incorporation of a time-dependent decision rule to address unequal penalties for classification errors. Validation experiments demonstrate that users of iWakeUp reported reduced sleepiness levels and increased vigor compared to a control group. The module is seamlessly integrated into the Sleep Coach system, currently

undergoing extensive field testing to validate real-world effectiveness and efficiency. In conclusion, the paper highlights the successful implementation and validation of iWakeUp, emphasizing its impact on users' alertness and well-being through video-based sleep monitoring and intelligent wake-up logic **[7]**.

The transformative impact of wireless sensor networks (WSNs) on home security systems, specifically focusing on the development and implementation of an adaptive intelligent alarm system within the context of smart homes. WSNs, comprised of small, autonomous sensor nodes monitoring various parameters, offer real-time control and monitoring capabilities in smart homes, enhancing safety and comfort. The highlighted paper proposes an adaptive intelligent alarm system utilizing WSNs to detect and respond to security threats, addressing the paramount concern of home security. The system's adaptability enables learning and adjustment to different scenarios, reducing false alarms and improving accuracy over time. The review emphasizes that such systems represent a significant advancement, leveraging WSN capabilities to ensure resident safety, and underscores the need for continued research to enhance these systems further. The potential integration of advanced technologies like microcomputers and advanced locking mechanisms holds promise for the future, making these systems even more effective in ensuring the safety and security of smart homes **[8]**.

III. METHODOLOGY

The implementation plan for an IoT Smart Alarm Clock is outlined systematically to ensure a successful deployment and operational efficiency. Commencing with a thorough requirement analysis, the plan aims to comprehend the specific needs and objectives of the smart clock. Subsequent stages involve the design and development of hardware, integrating key modules such as ESP328266, RTC Module (RTC3231), DHT11, LCD, Tactile Switches, and Buzzers. Rigorous prototype testing follows to validate functionality and performance, with refinement iterations as necessary.

The manufacturing and assembly phase focuses on maintaining quality control measures. Integration with requisite systems and infrastructure precedes comprehensive testing and optimization processes. The final steps encompass deployment, operational training, and ongoing maintenance and support, ensuring the continuous and effective performance of the IoT Smart Alarm Clock. The methodologies are executed in real-time utilizing a pre-programmed ESP32 board, showcasing a holistic approach to the successful implementation of this innovative technology.

The methodology for creating an IoT Smart Alarm Clock demands a meticulous understanding of ESP8266 boards, intricate wiring, and the seamless integration of various modules, requiring a delicate balance of sophistication and subtlety. The amalgamation of components, including the ESP8266 microcontroller, real-time clock (RTC) module, and environmental sensors, involves a nuanced approach to ensure optimal functionality. The ESP8266, serving as the system's brain, manages alarm features and facilitates Internet connectivity for remote control and synchronization.

The RTC module ensures precise timekeeping for reliability. Integrating environmental sensors, such as temperature and ambient light detectors, adds sophistication, allowing users to customize wake-up experiences based on environmental conditions. However, achieving this technical prowess requires careful attention to discreet wiring arrangements to prevent accidental damage and mitigate the risk of short circuits. The connections should be concealed to safeguard against user-induced harm to the device. This methodology underscores the precise knowledge and skill required for the successful creation of an IoT Smart Alarm Clock.

Node MCU ESP 8266 :

The NodeMCU ESP8266 is a versatile microcontroller tailored for IoT applications, featuring robust wireless connectivity with the ESP8266 Wi-Fi module. With a Tensilica L106 32-bit RISC processor and 4MB onboard flash memory for firmware and user data storage, it combines computational power with compact design. Supporting Lua scripting and seamlessly integrating with the Arduino IDE, it offers flexibility and ease of programming, making it accessible to a broad user base.[9][10]

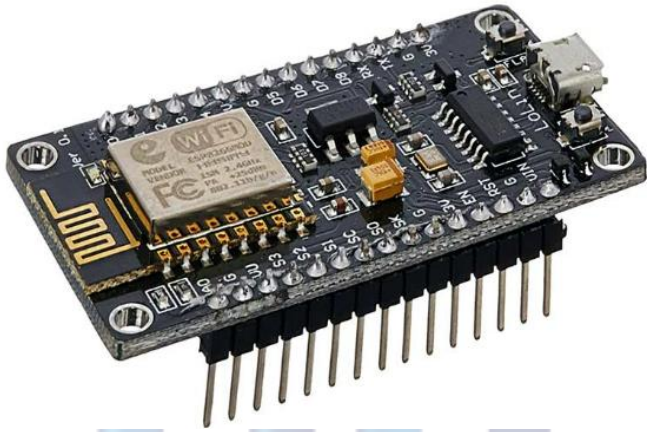

Figure 1 : NodeMCU ESP8266 [11]

DS3231 real time clock:

The DS3231 is a highly accurate real-time clock (RTC) module designed for precision timekeeping in various applications. It incorporates a temperature-compensated crystal oscillator (TCXO) and a real-time clock counter with built-in temperature compensation algorithms. This ensures exceptional timekeeping accuracy over a wide temperature range. With an I2C interface, it easily interfaces with microcontrollers like Arduino, providing accurate timekeeping for projects. The DS3231 also features integrated crystal and temperature sensors, making it an ideal choice for applications where precise timekeeping is crucial. The RTC module ensures the accurate tracking of seconds, minutes, hours, day, date, month, and year. It automatically adjusts the date for months with fewer than 31 days, incorporating corrections for leap years. The clock operates in both 24-hour and 12-hour formats, featuring an AM/PM indicator. Additionally, it offers two programmable time-of-day alarms and a customizable square-wave output. The communication of address and data occurs through a bidirectional I2C bus, enabling efficient and serial data transfer. [12]

Figure 2 : DS3231 [13]

LCD display:

Liquid Crystal Display (LCD) technology is a widely used method for visually presenting information in electronic devices. In the context of microcontrollers and embedded systems, 16x2 I2C LCD displays are particularly popular due to their ease of use and versatility. These displays, often featuring a 16-character, 2-line configuration, use the I2C communication protocol, simplifying the connection to microcontrollers. The I2C interface reduces the number of pins required for communication, streamlining the integration process. These LCD displays are commonly employed for presenting real-time data, sensor readings, or user interface elements in projects where visual feedback is essential. [14]

Figure 3 : LCD display [15]

DHT11:

The DHT11 humidity sensor is a reliable and cost-effective component for measuring humidity and temperature in various applications. This sensor utilizes a capacitive humidity sensing element and a thermistor to detect environmental conditions. It provides digital output for both humidity and temperature, making it easy to interface with microcontrollers. The DHT11 is known for its simplicity and accuracy in measuring ambient humidity and temperature levels. With its compact design and low power consumption, it is widely used in IoT projects, weather stations, and other applications where monitoring environmental conditions is crucial. [16]

Figure 4 : DTH11 [17]

I2C Module :

The I2C (Inter-Integrated Circuit) module serves as a crucial communication protocol in the realm of microcontrollers and embedded systems. It facilitates the seamless exchange of data between various components using a two-wire serial interface. Typically, an I2C module includes a master device and one or more slave devices connected through a common bus. This simplicity in wiring and the ability to connect multiple devices to the same bus make I2C a preferred choice for communication in projects involving sensors, displays, and other peripherals. The I2C module's bidirectional communication enables efficient data transfer, contributing to the overall effectiveness and simplicity of interconnected systems. [18]

Figure 5 : I2C Module [19]

IV. RESULTS

After the proper review from our literature we came to our final design (presented in methodology). Our final design have basic and some advance features covered. In future according to the user requirement we can make changes and make it more convenient for user. In our design we have introduced a panic button which is added in seeing the support for elderly people. We have added Google Calendar support which gives user reminders for their upcoming events.

The incorporation of Wi-Fi support in the alarm clock not only enhances current functionalities but also opens avenues for future developments. This includes the potential integration of voice assistance, connectivity with smart home devices, and the ability to receive over-the-air updates for continuous improvement and adaptability to emerging technologies. The Wi-Fi-enabled alarm clock becomes a versatile and future-proof device, promising exciting features and experiences ahead.

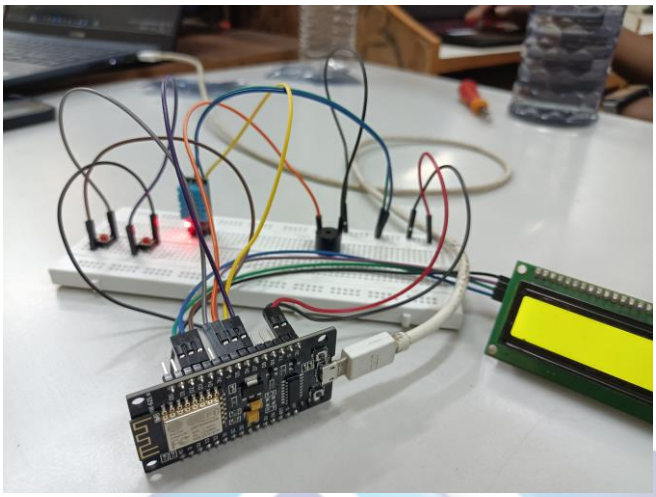

Figure 6 : Circuit Implementation

Output:

```
Temp: 24.60
Hum : 89.00
Date and Time :
Day: 29
Month: 11
Year: 2023
13:4:37
HTTP Response code: 200
{"coord":{"lon":76.7221,"lat":30.68},"we
Pressure API :33
Weather Conditions :"clear sky"
Temp: 24.60
Hum : 89.00
Date and Time :
Day: 29
Month: 11
Year: 2023
13:4:41
Temp: 24.60
Hum : 89.00
Date and Time :
Day: 29
Month: 11
Year: 2023
13:4:44
Temp: 24.70
Hum : 89.00
Date and Time :
Day: 29
Month: 11
Year: 2023
13:4:47
```

Figure 7 : Serial Monitor Output

V. CONCLUSION

In conclusion, this paper represents a meaningful convergence of technology and empathy, addressing a critical societal need—the well-being of the elderly. Utilizing NodeMCU8266 as our development board, we have crafted more than a Smart Alarm Clock; it is a purpose-driven solution. The inclusion of a panic alarm emphasizes our commitment to the safety and security of the elderly, offering timely assistance in emergency situations. The integration of a dedicated humidity sensor with an API for humidity and temperature marks a paradigm shift in environmental awareness for smart devices, ensuring real-time accuracy. The use of an API for real-time clock synchronization enhances the precision of our Smart Alarm Clock, catering to a world driven by punctuality. Beyond technical prowess, our project reflects a user-centric design approach, considering the multifaceted needs of our users. By infusing technology with empathy, we aim to contribute to a future where innovation seamlessly integrates into daily life, prioritizing not only convenience but also safety and overall well-being.

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