International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
Volume 52, Issue 05 and Publication Date: 23th August, 2023
An Indexed, Referred and Peer Reviewed Journal ISSN: 2319-6564
www.ijesonline.com

Smart Helmet Wiper

AKRAM RAZA ANSARI[1], SATYABRATA MISHRA[2], SOHAN DORA[3], DIPIKA SAHOO[4], I.V. PRAKASH[5]
[1,2,3,4,] Students, Department of Electronics and Communication Engineering, Gandhi Institute for Technology, Bhubaneswar, Odisha, India
[5] Professor, Department of Electronics and Communication Engineering, Gandhi Institute for Technology, Bhubaneswar, Odisha, India

Abstract: - ***Intelligent transportation systems are a significant focus in today's technological landscape. The integration of various sensor devices and autonomous vehicles not only enhances the comfort of drivers but also ensures safer driving conditions. In particular, for motorcyclists, helmets equipped with sensors serve as life-saving tools. Researchers have been concentrating on creating low-power, cost-effective smart helmets aimed at preventing road accidents. However, existing smart helmets are not designed to be adaptable to different seasons. This paper introduces an enhancement for smart helmets, incorporating a feature to help motorcyclists ride with greater ease during heavy rainfall. The system includes a wiper integrated into the helmet that is activated and deactivated through voice commands from the rider.***

***Keywords: Alexa Echo Input, NodeMCU, servo motor, Sinric*.**

1. INTRODUCTION

Advancements in technology and the widespread adoption of the Internet of Things (IoT) are transforming everyday devices into smart systems, enhancing convenience while keeping costs low. Examples of this transformation include Intelligent Transportation Systems, smart cities, and innovative healthcare devices. In India, a country known for its rich greenery, people experience a wide range of extreme climate conditions throughout the year. During the monsoon season, heavy rainfall often disrupts daily commuting, causing traffic congestion and sometimes leading to fatalities. A report from the Ministry of Transportation indicates that around 17 people lose their lives every hour in road accidents. Riding a motorcycle in such conditions becomes a daunting task. This paper proposes an extension for smart helmets, incorporating a voice recognition module to control a wiper mounted on the helmet's windshield. This feature will not only enhance the rider's visibility but also increase safety. The voice recognition could be powered by a generic voice module or a popular system like Amazon Alexa Echo Input. Both approaches are considered in this design. The system uses a NodeMCU ESP8266 as the microcontroller, with a servo motor controlling the wiper's operation. In the Alexa-based system, the rider's Android device acts as a wireless access point, facilitating communication between Alexa and the NodeMCU while also enabling the use of Alexa skills from the Amazon cloud.

II. RELATED WORKS

Michele Magno et al. [1] introduced a smart helmet equipped with low-power sensors and a Bluetooth integration module. They propose a dual power backup system to enhance the durability of the device, making it a reliable safety tool for motorcyclists. In [2], the authors suggest a helmet that detects the rider's head movements to control the motorcycle's headlight. The design includes a head-up display to reduce distractions and a helmet-mounted display to assist with navigation. Additionally, the helmet is integrated with a GSM module to send emergency notifications. Yu-Hsiu Hung et al. [3] developed a hazard warning helmet aimed at helping senior citizens riding scooters, particularly when passing through areas with double-parked vehicles. The helmet uses ultrasonic sensors and LEDs to provide warnings about obstacles, sending alerts through an Arduino Uno microcontroller. The system has been validated experimentally, showing that it improves safety and convenience for elderly riders. Mayank Sharma et al. [4] proposed a smart helmet for underground mining workers, integrating a wireless sensor network to monitor hazardous gases and other environmental parameters. The system includes sensors for temperature, humidity, and methane, and uses a Zigbee module for wireless communication. Although cost-effective and energy-efficient, the system could be further improved by making it season-friendly. Muthiah M et al. [5] introduced a motorcycle assistance system designed to enhance rider visibility during adverse weather conditions, such as heavy rain or snow. The helmet incorporates accelerometers to detect the rider's movement and adjusts the headlight intensity accordingly. An Arduino board controls the system, and an RF transmitter sends signals to manage the headlight and trigger an emergency buzzer.

There are also several research efforts aimed at responding proactively to accidents and emergency situations. One such method [6] uses pressure sensors and an Arduino board to detect accidents. The system then communicates the rider's location via a GSM module. However, this system may produce false positives or negatives when identifying accidents.

An improved approach is proposed by Sreenithy Chandran et al. [7], where an accelerometer detects changes in the bike's speed, triggering a GPS module. This setup relies on WiFi and cloud infrastructure but depends on internet connectivity and may require solar panel backup due to its power demands. In [8], a smart helmet is designed that prevents the motorcycle from starting unless the rider is wearing the helmet. The helmet is connected to the vehicle's ignition system, with a proximity sensor acting as an ON/OFF switch. Aditi Varade et al. [9] developed a helmet that ensures the rider wears it by disabling the vehicle's ignition if the helmet is not worn. In the event of an accident, the helmet automatically sends the rider's location to emergency contacts. While these studies have explored various smart helmet applications, none have addressed the need for season-friendly designs. This research gap is tackled in the present work, which proposes a voice recognition module and wiper extension for smart helmets, improving rider safety in rainy conditions.

III. SYSTEM MODEL USING GENERIC VOICE RECOGNITION MODULE

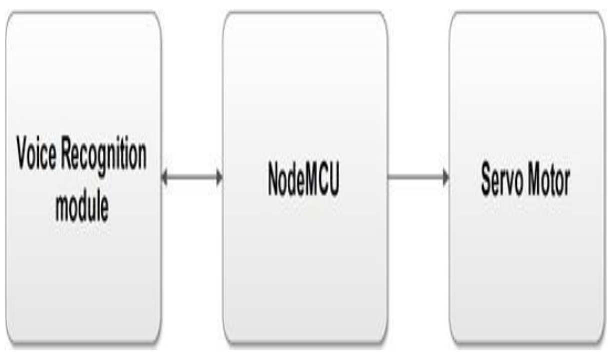

Fig. 1 Block diagram voice recognition module

The system model, illustrated in Fig. 1, consists of a NodeMCU microcontroller connected to a voice recognition module and a servo motor. NodeMCU is an open-source platform built on the ESP8266 WiFi chip, developed by Espressif Systems, which supports the TCP/IP protocol. This microcontroller features both analog and digital pins, similar to those on an Arduino board, and supports serial communication protocols like UART, I2C, and SPI, allowing it to interface with various devices such as LCDs, OLEDs, and sensors. It can be programmed using the Arduino IDE.

The voice recognition module plays a crucial role in capturing and recognizing voice commands. When a user's spoken words match prerecorded commands, the module sends corresponding codes to the NodeMCU. Based on the received codes, the NodeMCU can control the servo motor to turn it ON or OFF.

Voice Recognition Module Configuration

The voice recognition module must be configured before use. It is capable of storing up to 15 voice commands, divided into three groups of five commands each. The commands are recorded sequentially by importing a voice group via a serial command. To configure the module, it is connected to a Windows computer via a USB-to-serial adapter, as shown in Fig. 2. The Access port serial tool on the computer is used to send commands to the module.

Voice Command Recording Process

Once the module is connected to the computer, the first voice command is recorded after the "START" message appears on the Access port serial tool interface. The user must repeat the command twice to ensure accuracy. If the voice commands match, a "FINISHED ONE" message will be displayed, confirming successful recording. The same process is followed for the subsequent voice commands in the group.

After recording all commands, the system will display a "GROUP1 FINISHED" message. At this point, the module should be switched to compact mode, which allows it to recognize voice commands. This mode is activated by sending specific command bytes (0xAA and 0x37) to the module. To import the recorded group, command bytes (0xAA and 0x21) are sent, and when a command is spoken, the module will return a corresponding code (e.g., 0x11 for the first command, 0x12 for the second, and so on).

Connection and Voltage Level Shifting

The voice recognition module operates on a 5V supply, while the NodeMCU uses 3.3V. To ensure compatibility between the two, a voltage level shifter is used. The TxD line of the voice recognition module is connected to the RxD line of the NodeMCU through the level shifter, which converts the 5V signal to 3.3V. Similarly, the TxD line of the NodeMCU is connected to the RxD line of the voice recognition module, where it converts the 3.3V signal to 5V.

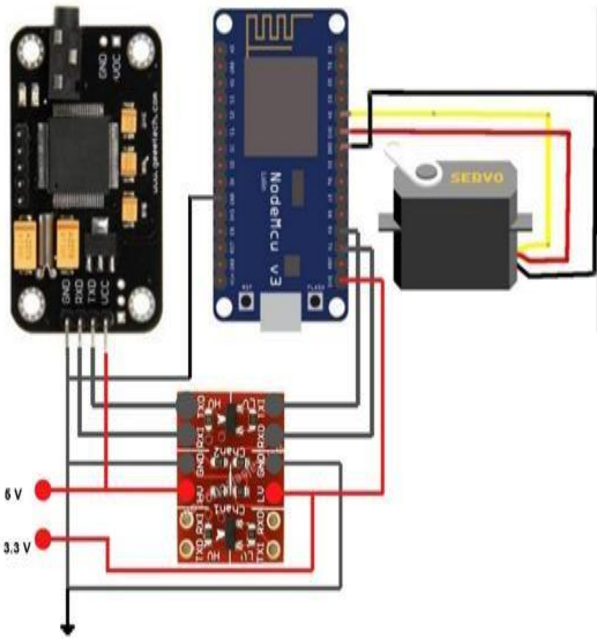

Fig. 2 illustrates the connections between the NodeMCU, voice recognition module, and servo motor.

Servo Motor Control

The servo motor is used to precisely control angular rotation. It is driven by a PWM (Pulse Width Modulation) signal, which is generated by the PWM-capable GPIO pin on the NodeMCU. The motor's angular position is adjusted based on the PWM signal, allowing it to be controlled as needed for the system's operation.

IV. SYSTEM MODEL USING AMAZON ALEXA ECHO INPUT

As shown in Fig. 5, the smart helmet system is designed using Amazon Alexa Echo Input, NodeMCU, and a servo motor. The motorcyclist's Android smartphone is configured as a Wireless Access Point to enable communication between the Alexa and NodeMCU devices. Amazon Alexa Echo Input is initially set up using the Amazon Alexa app on the mobile device, which also allows access to Alexa's cloud-based skills.

Voice Command Integration

The system responds to voice commands such as "Viper ON" and "Viper OFF." When the "Viper ON" command is given, the system generates a PWM waveform on the GPIO pin connected to the servo motor to activate it. Conversely, the "Viper OFF" command sends a logic LOW signal to turn off the motor.

Communication Setup with Sinric Skil

To enable communication between the Alexa Echo Input and NodeMCU, the system uses the Amazon skill called *Sinric*. This skill can be accessed by creating an account at sinric.com. After logging in, a new smart home device can be added, generating a unique API key for the device. The *Sinric* code from GitHub [10] is uploaded to the NodeMCU to control the connected device through Alexa's voice commands. Before uploading this code to the NodeMCU using the Arduino IDE, two libraries—*deviceWebSocketsClient.h* and *ArduinoJson.h*—must be installed. The generated API key is used as the device ID in the turnON() and turnOff() functions:

cpp
CopyEdit

```
void turnOn(String deviceId) {
  if (deviceId == "xxxxxxxxxx") {  // Device ID
    digitalWrite(device1, HIGH);
  }
}

void turnOff(String deviceId) {
  if (deviceId == "xxxxxxxxxx") {  // Device ID
    digitalWrite(device1, LOW);
  }
}
```

Device Discovery and Status Updates

Once the Sinric code is uploaded to the NodeMCU, the Sinric skill is enabled in the Alexa app, and Alexa is prompted to discover the new device. The device and its status can then be viewed, as shown in Fig. 6 and Fig. 7.

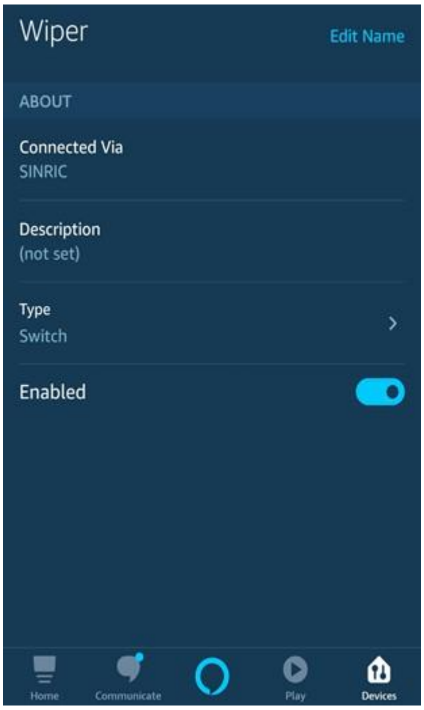

Fig. 6: Wiper Connection to Alexa through Sinric

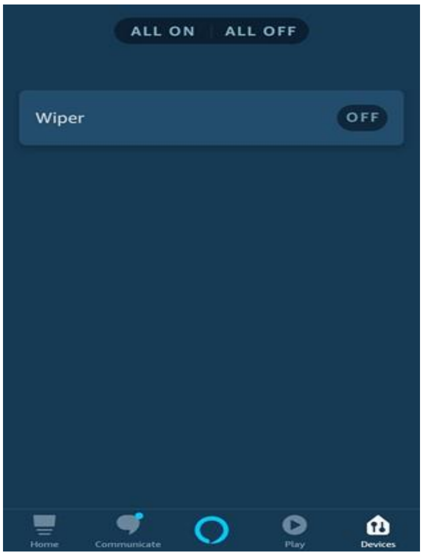

Fig. 7: Wiper Status Based on Voice Command

V. RESULTS AND DISCUSSION

The system utilizing the generic voice recognition module is cost-effective and simple to implement. However, it tends to be speaker-dependent, meaning the individual who records the voice must be the intended user. Additionally, the system's responsiveness decreases in noisy environments, likely due to the low-quality microphone used in the voice recognition module. A better-quality microphone could mitigate this issue. On the other hand, the system based on Amazon Alexa Echo Input, while slightly more expensive, is both speaker-independent and more effective in noisy conditions, making it a more reliable choice for this design.

VI. CONCLUSION

This paper presents a voice-controlled wiper system as an enhancement to smart helmets, aimed at making them more adaptable and season-friendly. Two system designs are proposed: one using a generic voice recognition module and the other using Amazon Alexa Echo Input. The designed systems can be integrated with existing smart helmet technologies as reported in previous studies. While the current design focuses on controlling the wiper, there is potential to expand the system to include other features such as voice-controlled air conditioning, helmet-mounted indicators, and navigation, all of which can be connected via additional modules on the NodeMCU.

REFERENCES

[1] Magno, M., D'Aloia, A., Polonelli, T., Spadaro, L., & Benini, L. (2017). SHelmet: An intelligent self-sustaining multi-sensors smart helmet for bikers. In M. Magno, F. Ferrero, & V. Bilas (Eds.), Sensor systems and software: S-CUBE 2016 (Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, Vol. 205, pp. 219–226). Springer.

[2] Chiu, W.-C., Hsieh, P.-H., Wu, W.-L., & Lin, C.-L. (2017). Helmet-mounted display system of motorcyclist with collision detecting and navigation. In S. L. Peng, G. L. Lee, R. Klette, & C. H. Hsu (Eds.), Internet of vehicles: Technologies and services for smart cities (Lecture Notes in Computer Science, Vol. 10689, pp. 317–324). Springer.

[3] Hung, Y.-H., Hsu, H.-C., & Huang, Y.-F. (2016). Design and evaluation of an innovative hazard warning helmet for elder scooter riders. In M. Antona & C. Stephanidis (Eds.), Universal access in human-computer interaction: Users and context diversity (Lecture Notes in Computer Science, Vol. 9739, pp. 243–251). Springer.

[4] Sharma, M., & Maity, T. (2018). Low cost low power smart helmet for real-time remote underground mine environment monitoring. Wireless Personal Communications, 102(1), 149–162.

[5] Muthiah, M., Natesh, A. V., & Sathiendran, R. K. (2015). Smart helmets for automatic control of headlamps. In Proceedings of the International Conference on Smart Sensors and Systems (IC-SSS), IEEE.

[6] Ajay, A., Vishnu, G., Kishoreswaminathan, V., Vishwanth, V., Srinivasan, K., & Jeevanantham, S.

(2017). Accidental identification and navigation system in helmet. In Proceedings of the International Conference on Nextgen Electronic Technologies: Silicon to Software (ICNETS2), IEEE.

[7] Chandran, S., Chandrasekar, S., & Elizabeth, N. E. (2016). Konnect: An Internet of Things (IoT) based smart helmet for accident detection and notification. In Proceedings of the Annual India Conference (INDICON), IEEE.

[8] Nandu, R., & Singh, K. (2017). Smart helmet for two-wheelers. Advances in Automobile Engineering, 3(1), 1–7.

[9] Varade, A., Gajbhiye, N., Mousam, & Panchbhai, V. V. (2017). Smart helmet using GSM and GPS. International Research Journal of Engineering and Technology, 4(3), 2049–2054.