Accessible Home: Empowering Disability with Smart Home Automation

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***Abstract*— In today's world, technology has the power to make life easier for everyone, including those with disabilities. The prototype includes the installation of various smart devices, such as automated entrance system, smart thermostats, smart leakage sensors, and automated lighting systems. Three individual nodes namely home access, gas detection, light automation and fall detection are proposed which are connected to a master node. A RFID card is used to access the entry gate at node 1. The second node detects LPG and carbon monoxide. When the sensors detect gas above threshold value, buzzer goes off alerting everyone. Temperature and humidity values are displaced on their OLED watch screen and speed of lights and fan using the relay. The third node detects a person's falls that will send notification to the emergency contact via Telegram and WhatsApp. All the three nodes are connected with the master node using ESP-01. The user can be instantly notifiedabout any unusual event on their watch using ESP-NOW.**

***Keywords*— RFID, Smart Watch, OLED, ESP-NOW**

I. INTRODUCTION

Home automation has become an innovative trend in the modern world of technology breakthroughs, changing how we interact with and regulate the places we call home. This technology transformation offers the possibility of a more open, self-sufficient, and satisfying way of life for people with disabilities. Home automation includes a variety of gadgets and systems that may be connected into residential settings to automate certain operations and provide homeowners more control over certain aspects of their homes. The World Health Organization estimates that approximately 15% of the global population lives with some form of disability, ranging from mobility impairments to sensory and cognitive challenges. Simple daily tasks that most people take for granted can become big problems for these people, lowering their independence and overall quality of life. Some of the reported literatures are discussed. The home automated systems using IoT [9-12] and Arduino based systems [1-8] helps in smart home technologies aimed at enhancing the health and independence of older adults. In [4], authors have presented a home security system using Arduino, ESP8066 and it aims at designing an advanced home automation system using normal web server and Wi-Fi technology to monitor and control the security of a smart home environment. The authors in [6] described a method and apparatus for prevention of fire detection algorithms used data from sensors for temperature, smoke, and combustion products. The development of a home automation system discussed in [9] utilizes IoT and an Android application for controlling various household devices remotely. The authors focus on enhancing user convenience and energy efficiency in smart homes especially for elderly people.

The authors presented a system for interconnecting sensors [12], actuators, and other data sources with the purpose of multiple home automations. The benefits of the proposed prototype are numerous. It not only promotes independence and autonomy but also enhances the quality of life for individuals with disabilities. With the proposed prototype, people with disabilities can enjoy a comfortable and safe living environment that is tailored to their unique needs. Overall, the Accessible Home project is a step towards creating a more inclusive society, where everyone has access to the same opportunities and resources. Studying home automation for people with impairments is really important on a number of aspects. By promoting increased independence, social inclusivity, and safety and security through modern technologies, it promises to improvetheir quality of life overall. Additionally, it can lighten the strain on loved ones, resulting in financial savings and promoting advancements in technology. In the end, it increases public awareness of the difficulties that individuals with disabilities confront and emphasizes the value of establishing inclusive and accessible living spaces, taking steps towards a more just and compassionate future for all.

II. METHODOLOGY

Three distinct nodes, each with a specific task to complete, have been created for our project andare each connected to a master node. The first node, which will serve as an automated entry system,is made up of an RFID reader, NodeMCU-ESP8266, and a servo motor as shown in figure 1. To getentry when trying to enter and to close the door when leaving, a person must scan a card or keyring. The second node is made up of Arduino Uno, DHT11 temperature and humidity sensors, MQ2and MQ7 carbon monoxide and LPG sensor, a buzzer and a relay as shown in figure 2. The DHT11 sensor will display the temperature and humidity on the OLED screen on the watch, and we can control the lights using relay and when the sensors detect LPG or carbon monoxide above the threshold value the buzzer will start and exhaust fan will turn on for ventilation. The third node known as the

master node includes an OLED, button, an accelerometer, a pulse sensor and NODEMCU-ESP8266 as shown in figure 3.The third node is designed to be worn as a watch, and ifthe user falls and is unable to get up the MPU6050 will alert the emergency contact via Telegram and WhatsApp. Additionally, there are panic button that, when hit, will alert family members via Telegram and WhatsApp. A pulse sensor will display the user's heart rate on the OLED. ESP-NOWis a communication protocol which allows devices to directly communicate with each other without the need for a centralized router or access point. The ESP-01 will be used to connect all three nodes to the master node so that the user can receive notifications on their watch immediately. The first node will communicate the entry access data which is door open and door close and the second node all will communicate all the sensor values such as temperature, smoke and carbon monoxideto the master node which will show notifications on the watch and will send notifications via Telegram and WhatsApp as shown in figure 4. The algorithm for the same is shown in Figures 5, 6, 7 along with their circuit diagram, experimental setups in figures 8, 9, 10 and results shown in Figures 11 to 19.

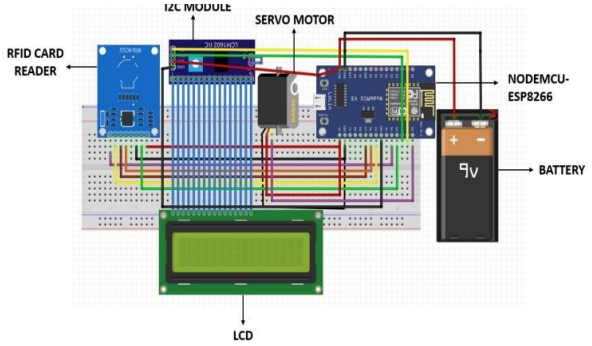

Figure 1: Circuit Diagram of our first node using Fritzing

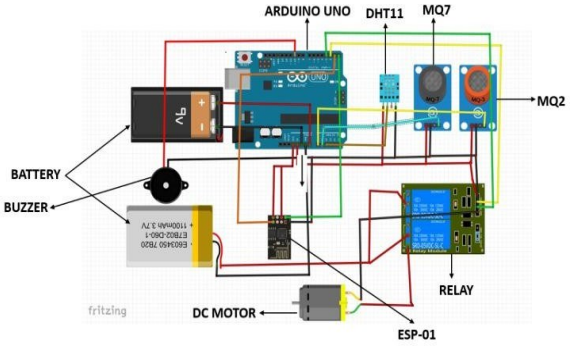

Figure 2: Circuit Diagram of our second node using Fritzing

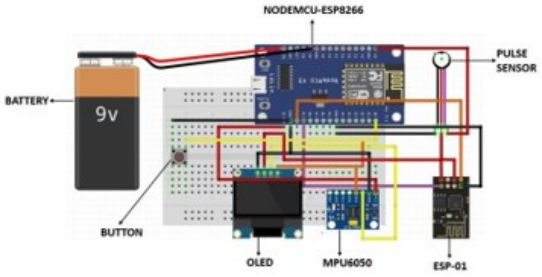

Figure 3: Circuit Diagram of our master node using Fritzing

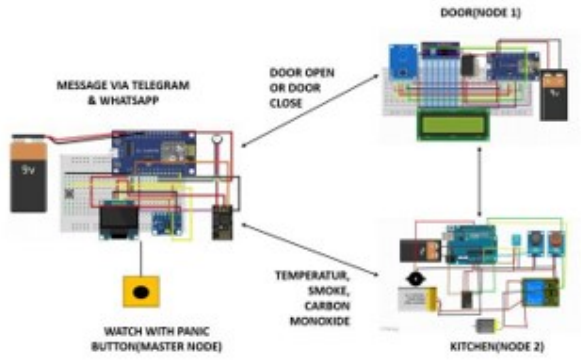

Figure 4: Connection among all the nodes

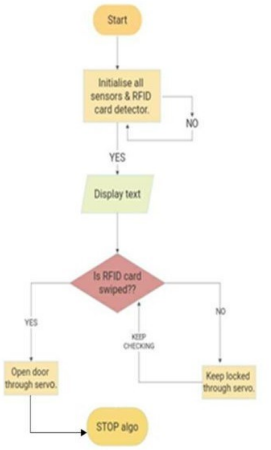

Figure 5: Algorithmic Chart of our Node

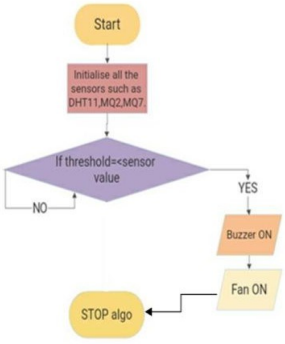

Figure 6: Algorithmic Chart of ourFirst Second Node

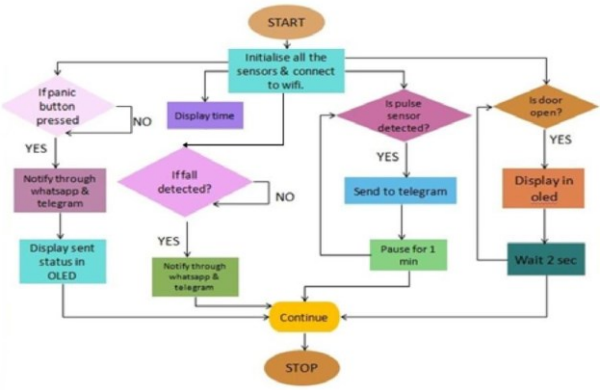

Figure 7: Algorithmic Chart of our master node

III. RESULTS

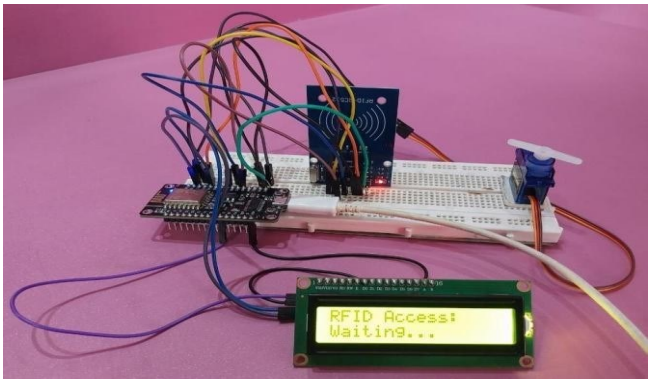

Figure 8: Experimental Setup of Our First Node

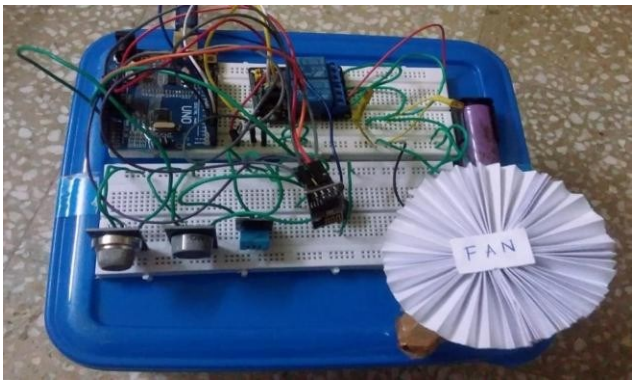

Figure 9: Experimental Setup of Our Second Node

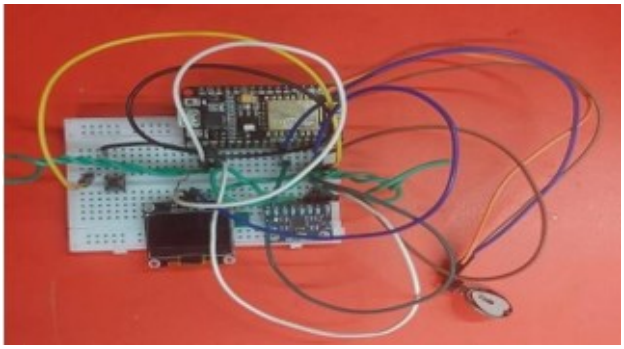

Figure 10: Experimental Setup of Our Master Node

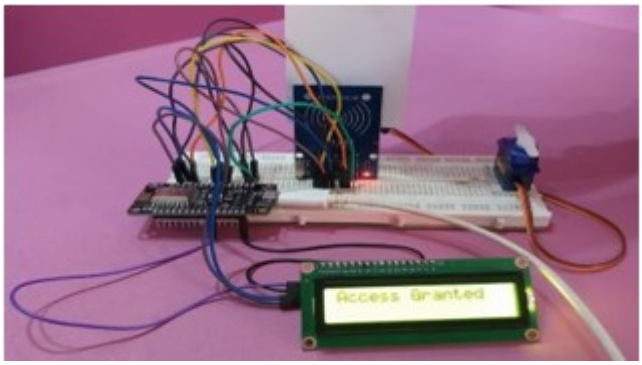

Figure 11: When Card is tapped LCD showsAccess Granted and servo opens

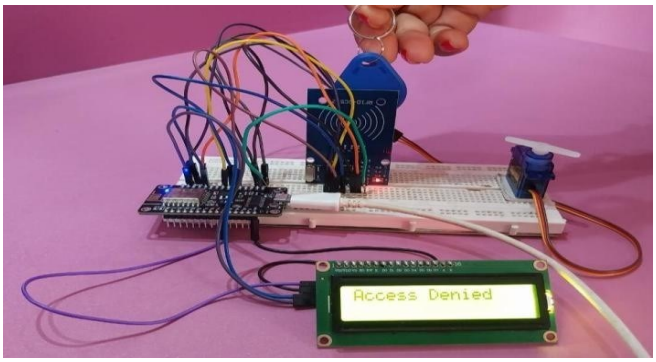

Figure 12: When Keychain is tapped LCD shows Access Deniedand servo closes

```
LPG Value: 220
Smoke Value: 205
Temperature: 30.90
Humidity: 85.70
LPG Value: 221
Smoke Value: 206
Temperature: 30.90
Humidity: 85.50
LPG Value: 220
Smoke Value: 205
Temperature: 30.90
Humidity: 85.50
```

Figure 13: Initial values from all when nothing is present

```
LPG Value: 369
Smoke Value: 204
Temperature: 30.90
Humidity: 85.00
LPG Value: 363
Smoke Value: 207
Temperature: 30.90
Humidity: 85.00
LPG Value: 338
Smoke Value: 223
Temperature: 30.90
Humidity: 85.00
LPG Value: 270
```

Figure 14: Values from the sensors the sensors when high LPG is detected

```
LPG Value: 243
Smoke Value: 343
Temperature: 30.90
Humidity: 85.00
LPG Value: 244
Smoke Value: 326
Temperature: 30.90
Humidity: 85.00
LPG Value: 240
Smoke Value: 325
Temperature: 30.80
Humidity: 89.70
```

Figure 15: Values from the sensors smoke is detected

{"LPG":254,"Smoke":219,"Temperature":30.4,"Humidity":85.2,"Relay1On":true,"Relay2On":true}
{"LPG":244,"Smoke":208,"Temperature":30.5,"Humidity":85.1,"Relay1On":true,"Relay2On":false}
{"LPG":240,"Smoke":209,"Temperature":30.5,"Humidity":83.8,"Relay1On":true,"Relay2On":false}
{"LPG":236,"Smoke":266,"Temperature":30.5,"Humidity":83.8,"Relay1On":true,"Relay2On":false}
{"LPG":236,"Smoke":361,"Temperature":30.5,"Humidity":83.8,"Relay1On":true,"Relay2On":false}
{"LPG":236,"Smoke":373,"Temperature":30.5,"Humidity":84.1,"Relay1On":true,"Relay2On":true}
{"LPG":237,"Smoke":364,"Temperature":30.6,"Humidity":83.4,"Relay1On":true,"Relay2On":true}
{"LPG":245,"Smoke":344,"Temperature":30.5,"Humidity":84.3,"Relay1On":true,"Relay2On":true}
{"LPG":232,"Smoke":337,"Temperature":31.2,"Humidity":83.9,"Relay1On":true,"Relay2On":true}
{"LPG":244,"Smoke":326,"Temperature":30.6,"Humidity":84.1,"Relay1On":true,"Relay2On":true}
{"LPG":232,"Smoke":323,"Temperature":30.5,"Humidity":84.1,"Relay1On":true,"Relay2On":true}
{"LPG":227,"Smoke":306,"Temperature":30.6,"Humidity":83.6,"Relay1On":true,"Relay2On":true}
{"LPG":237,"Smoke":280,"Temperature":30.5,"Humidity":84.6,"Relay1On":true,"Relay2On":true}
{"LPG":226,"Smoke":273,"Temperature":30.6,"Humidity":79.5,"Relay1On":true,"Relay2On":false}
{"LPG":225,"Smoke":267,"Temperature":30.6,"Humidity":84.1,"Relay1On":true,"Relay2On":false}
{"LPG":226,"Smoke":263,"Temperature":30.5,"Humidity":84.1,"Relay1On":true,"Relay2On":false}
{"LPG":239,"Smoke":272,"Temperature":30.6,"Humidity":84.1,"Relay1On":true,"Relay2On":false}
{"LPG":230,"Smoke":261,"Temperature":30.6,"Humidity":84.1,"Relay1On":true,"Relay2On":false}
{"LPG":230,"Smoke":257,"Temperature":30.6,"Humidity":84.3,"Relay1On":true,"Relay2On":false}
{"LPG":228,"Smoke":253,"Temperature":30.6,"Humidity":84.1,"Relay1On":true,"Relay2On":false}

Figure 16: Transmitted JSON packet using when high ESP-NOW

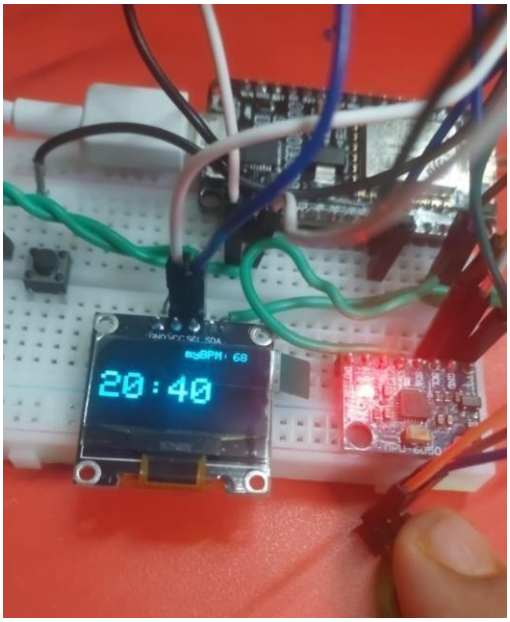

Figure 17: Time and Heart Rate on OLED

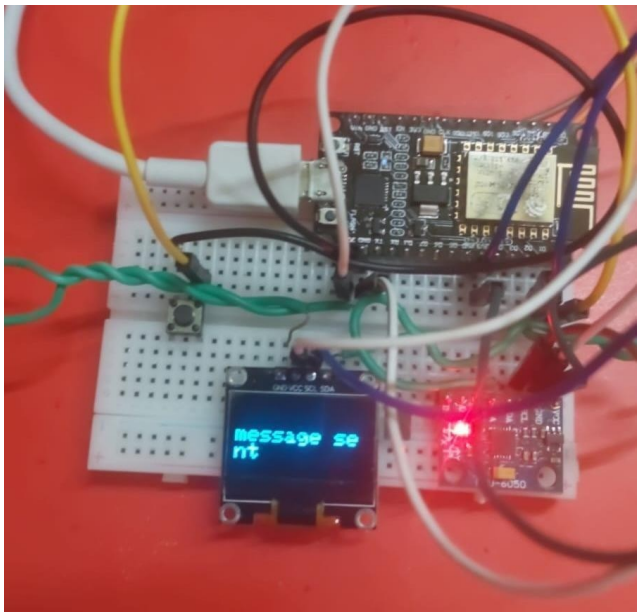

Figure 18: Message displayed on OLED when panic button pressed

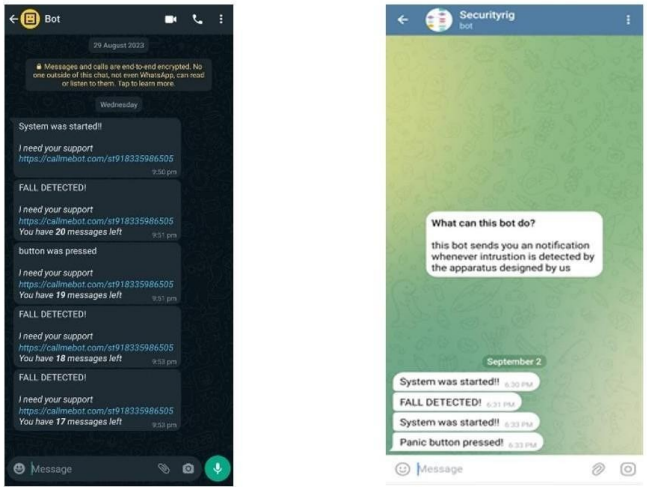

Figure 19: Automated Message VIA WhatsApp and Telegram when fall Detected & panic button pressed

CONCLUSION

Home automation has emerged as an innovative force in the wake of rapid technical advances, providing an abundance of opportunities for people with disabilities. Our study displayed that home automation technologies have a significant impact on disabled people's independence and general quality of life. These technologies have evolved to be more inclusive, adaptable, and intuitive with user-centered design concepts at their core, thereby removing obstacles to daily activities. In a nutshell home automation offers a viable way to make the environment moreaccessible and inclusive for those with impairments. It encourages inclusivity, improves safety, lessens the strain on the loved ones, and fosters innovation while enabling users to live more independent lives. We can create a future where technology serves as an efficient tool for equality, autonomy, and a higher standard of living for all members of society by recognizing its innovative potential.

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