An IOT Based Smart Home Architecture for People In Special Needs

Vishal Jadhav, Shivam HudgeAjit Jha,
Bhushan Mahajan
Students, Dept. of Computer SAOE,
Pune, Maharashtra, India,

Mrs. H. A. Bhute
Professor, Dept. of Computer SAOE,
Pune, Maharashtra, India.

Abstract – Internet of things have been pushing for ubiquitous computing in all spheres of life and simplify human interfacing with technology. The main aim of this technology is to increase efficiency and decrease effort. Technology increases the connectivity of devices within the home for reliable communication and makes home automation more reliable.
This paper gives an implementation of the IOT based smart home automation that supports for disabled people using Natural Language Processing (NLP). By using this system user can control the home equipment automatically using wireless communication with the smartphone. The system can track and analyze the behavior of the residents at multiple time scales and provide reports and alerts to the caretaking staff. Motion sensor helps to detect the presence of the person in the room. The proposed system is designed to analyze all activities of the people and to provide reports on their activity to the care taking staff.

Keywords – Smart Home Automation, Voice Input, Voice To Text Conversion, Hardware Interfacing, Sensor Data, ID3 Algorithm, User Notification, People With Special Needs.

I. INTRODUCTION

The use of the Internet of things or IoT added the extra potential for monitoring the remote controlling devices. Internet of things (IoT) can minimize human efforts. It analyzes the data retrieved from the sensors and performs appropriate activities thereby saving human time. Automation [1][2] is one such area that aims to achieves simplicity whiles increasing efficiency. Smart home systems are gaining importance in recent years due to affordability and simplicity through smartphone and tablet connectivity. Such systems are more useful for peoples with special needs. People with disabilities require assistance to do their daily routines, therefore nurses are employed to assist them. But middle-aged people prefer to live independently and self-managing in their own home which gives the feeling of independence. Using smart home systems will reduce expenditure and is more beneficial than attending medical centers. This type of system with remote monitor controls and health care capability will decrease the cost of personal aid assistance at home. Such a system uses computers or mobile devices to control basic home functions and features automatically through the internet from anywhere. It also gives a powerful means for helping and supporting the special needs of people with disabilities and, specifically, the elderly.

Here we are implementing a system where users can give voice input through an android application for ON or OFF any device he wants. The voice to text conversion can be done using Google API so that the system can understand the commands given by the user. The system can gather the data through the hardware kit (Temperature Sensor, Pressure Sensor, Water Flow Sensor, Motion Sensor, LDR Sensor, [4] etc.) and send it to the server using WIFI based Arduino Wemos Microcontroller. The system shows the current sensor data received from the hardware kit with the help of the server. The system also checks the sensor data and gives the proper response. The notification decision can be taken using the ID3 algorithm. After sending a notification to the users, the systems also send the instructions to the kit for ON/OFF the light relay.

A. Objectives of the Proposed System

- To enhance the quality of life of the people with special needs by providing comfort, and convenience.
- To provide voice input for ON/OFF the device.
- Provides low cost and high usability system that avoid Manual work.
- Help to detect unusual activities or movements inside the house.

II. LITERATURE REVIEW

Burgoji Santhosh Kumar et a.[1] proposed a microcontroller-based voice-controlled home automation system using smartphones. The control circuit consists of an Arduino Uno microcontroller, which processes the user commands and controls the switching of devices. A microcontroller-based voice-controlled home automation system using smartphones. The control circuit consists of an Arduino Uno microcontroller, which processes the user commands and controls the switching of devices.

Garima Tripathi et al.[2] proposed the Intelligent System continuously learns and adapts to the user's preferences using Natural Language Processing. The Intelligent System will execute the commands issued by the user. The AI system will infer the changes and

implement them with the help of the Raspberry Pi. On issuing a command to the system, the Raspberry Pi will map the command to the Arduino device in the specific rooms.

Mohd Helmy Abd Wahab et al.[3] presented an IoT-based Home Automation System is designed to assist people with physical disabilities. The design is using an embedded controller board and the home appliances are physically connected to output ports of this board via relays. The main control system using wireless communication technology to provide remote access from tablets or smartphones. Cytron BlueBee is used to establish wireless communication between the Android phone and the Arduino Uno board. The mobile application is developed to provide a user-friendly graphical user interface (GUI) for remotely controlling on home appliances.

Gagan et al.[4] presented smart home monitoring and alerting system for a disabled person. The proposed model uses intel galileo board to achieve the monitoring of humidity and temperature, gas, smoke, motion, and fire and controlling different electrical appliances like fan, heater, lights, etc. If the sensor value exceeds the threshold value system should alert the user. Alerting and other data are sent to users through the internet.

Farzeem D. et al.[5] proposes a centralized management system that will allow users to control domestic appliances and services with voice and also make electronic decisions on the end user's behalf such as monitoring, improving comfort, convenience, controlling surrounding conditions, and delivering required information whenever needed.

Shubham Kumar et al.[6] proposed a Smart Home Automation system using Natural Language Processing (NLP) system that controls that remotely control smart homes in a secure and customized manner. The system monitor home devices with the application of Google API for integrating devices.

Cyril Joe Baby et al.[7] proposed a home automation system in which Some lights and fans at home are fully automated based on sensor inputs. Lights are automated based on the inputs from motion detected and the fans are automated based on the temperature. The door lock can be controlled by giving voice commands. The system has a speech recognition module using Natural Language Processing and hence voice commands can be understood and the home can be automated accordingly.

III. PROPOSED SYSTEM

We are developing a system user can control the home equipment automatically using wireless communication with the smartphone. The proposed system architecture for smart homes supports people with special needs. The system can track and analyze the behavior of the residents at multiple time scales and provide reports and alerts to the caretaking staff. Motion sensor helps to detect the presence of the person in the room. Figure 1 shows the architecture of the proposed system with detailed working of the system..

1. **User Registration:** The user should be registered in the system. They can add their details like phone number, username, password, etc.
2. **User Voice Input:** As the system helps people with special needs, the user can give voice input through android application for ON or OFF any device he wants. The voice to text conversion can be done using Google API so that the system can understand the commands given by the user.
3. **Get Sensor Data:** The Arduino board is a hardware interface allowing you to control and monitor the different sensors using wireless communication. The system can gather the data through the hardware kit and send it to the server using WIFI based Arduino Wemos Microcontroller. The hardware kit contains the following sensors.

- **Temperature Sensor-** The temperature sensor dht11 is used to sense the temperature in the room. Sensor controls fan in the room depending on the temperature of the room. If it is high system automatically switches ON the fan.
- **Pressure Sensor:** It helps to find the position of the person.
- **Water flow Sensor:** We are using flow controlled water meter sensor for checking of the water from taps.
- **Motion sensor:** The motion sensor helps to detect presence of the person in the particular room.
- **LDR Sensor:** The LDR sensor is used to check the light intensity. If the light is low, system will switch on the light or off using there smart phone based on lighting condition.

4. **View Sensor Data:** The user can view the sensor data through the system. The system shows the current sensor data received from the hardware kit with the help of the server.
5. **Check Sensor Data:** The system checks the sensor data and gives the proper response. It checks the sensor values against the predefined sensor limits. If the sensors values exceed the limit then the system can send **the response to the kit and also send alert to the user.**
6. **Apply ID3 Algorithm:** The system sends alert notification to the user If the sensor is cross the normal range. And the notification decision can be taken using the ID3 algorithm.
7. **Send Response to Kit:** After sending a notification to the users, the systems also send the instructions to the kit for ON/OFF the light relay.

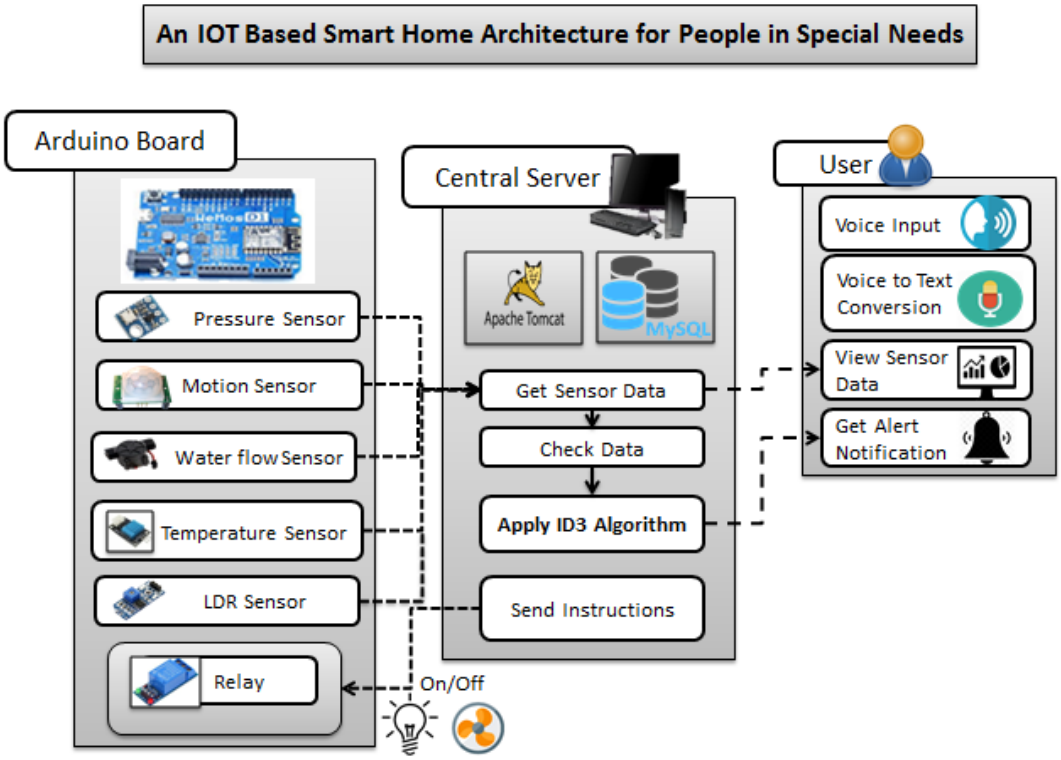

Figure 1: System Architecture

The overall flow of the proposed system is shown in figure 2.

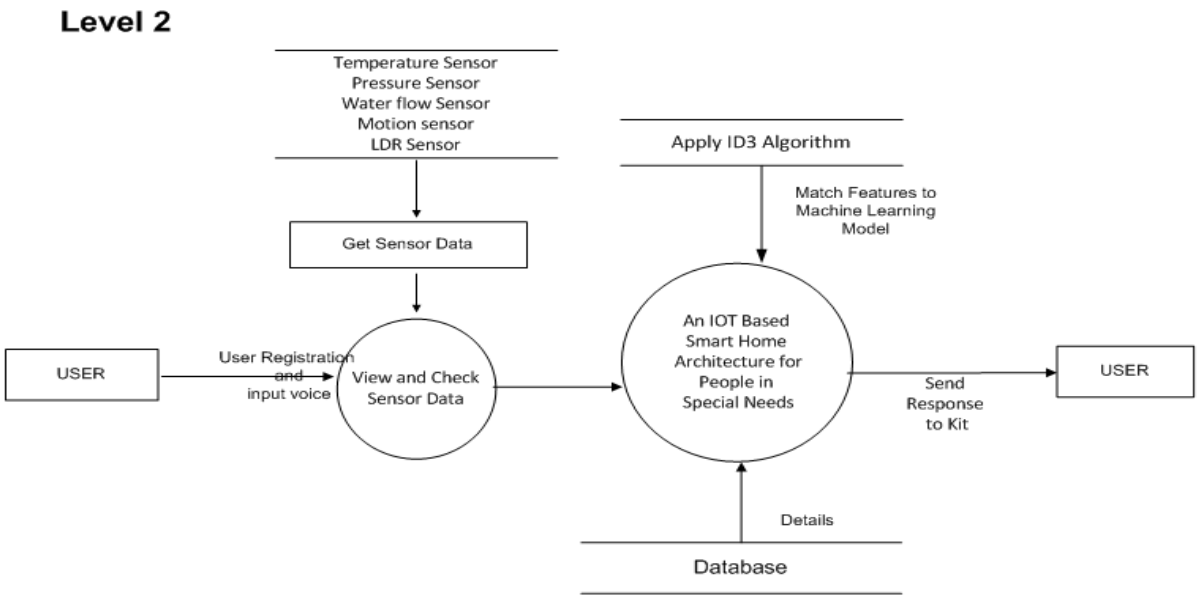

Figure 2: Data Flow of the Proposed System

IV. TECHNOLOGY USED

- ID3 builds a decision tree from a fixed set of examples. The resulting tree is used to classify future samples. The leaf nodes of the decision tree contain the class name whereas a non-leaf node is a decision node. The decision node is an attribute test with each branch (to another decision tree) being a possible value of the attribute. ID3 uses information gain to help it decide which attribute goes into a decision node.

- **Algorithm** :
  1) Establish Classification Attribute (in Table R)
  2) Compute Classification Entropy.
  3) For each attribute in R, calculate Information Gain using classification attribute.

4) Select Attribute with the highest gain to be the next Node in the tree (starting from the Root node).
5) Remove Node Attribute, creating reduced table RS.
6) Repeat steps 3-5 until all attributes have been used, or the same classification value remains for all rows in the reduced table.

- ENTROPY:

$$H(X) = -\sum_{i=1}^{n} p(x_i) \log_b p(x_i)$$

ENTROPY(S) = -p+log2(p) + -p_log2(p)

Where;

- P+ is the proportion of Positive examples.
- P- is the proportion of Positive examples
- ENTROPY(S) = 0 if all members of S belong to the same class.
- ENTROPY(S) = 1 (Maximum) When all the members are split equally.
- ∑ is over total outcomes.
- Log2 is lag base 2

Example:-

If S is the collection of 14 examples with 9 YES and 5 No then;

ENTROPY(S) = - (9/14) Log 2 (9/14) – (5/14) Log 2(5/14)

=0.940.

- INFORMATION GAIN:

$$\text{Gain}(S, A) = ENTROPY(S) - \sum_{v \in Values(A)} \left(\frac{|Sv|}{|S|} ENTROPY(Sv) \right)$$

Where,

- Values (A) are the set of all possible values of attributes A.
- S= (SYES,SNO)
- Sv is the Subset of S for which attribute A has value v.

V. RESULT SCREENSHOTS

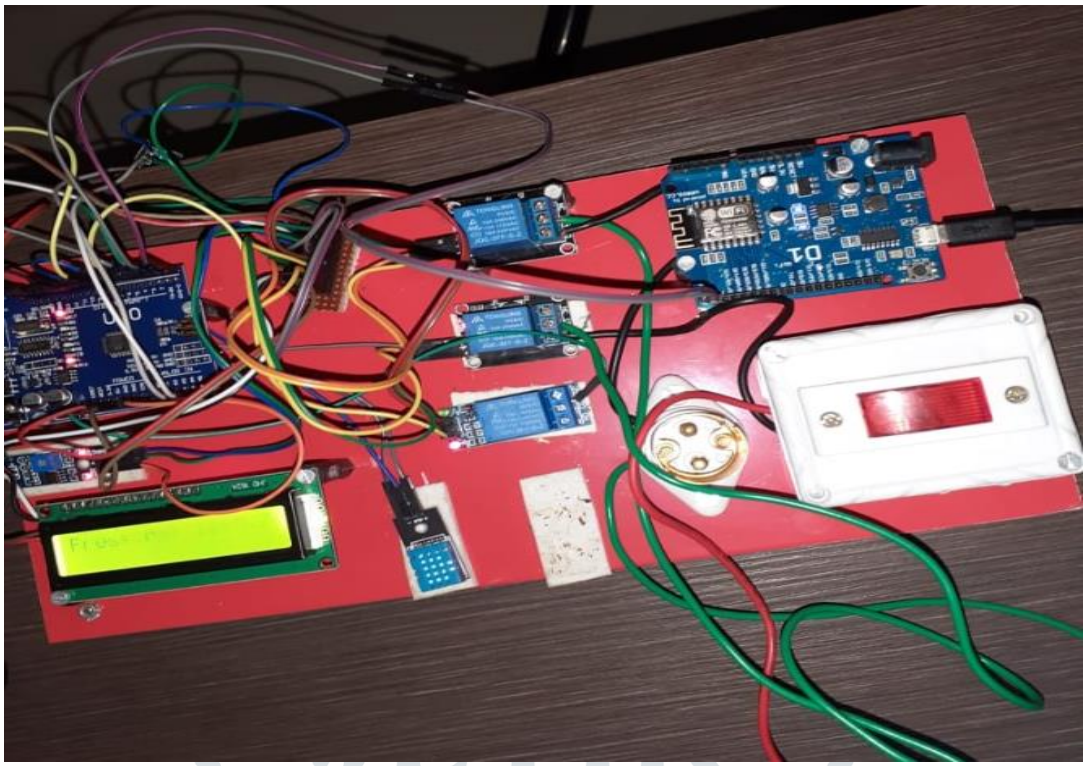

Figure: - Experimental Setup

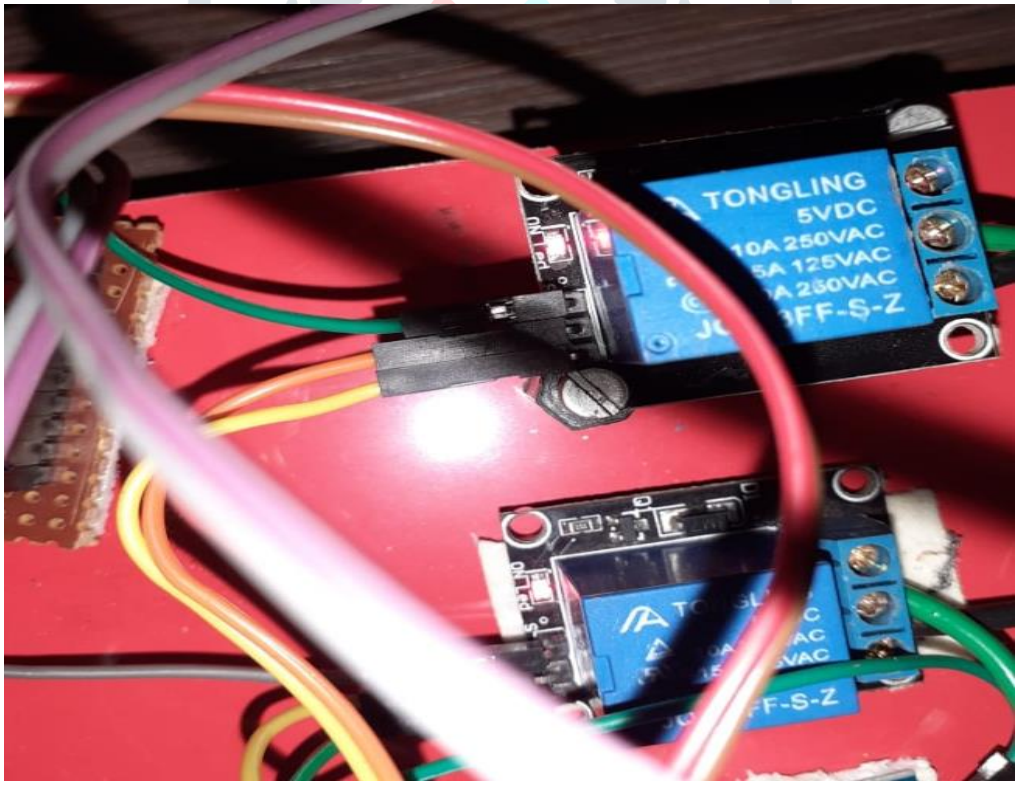

Figure: - ON/OFF the light

After sending a notification to the users, the systems also send the instructions to the kit for ON/OFF the light relay.

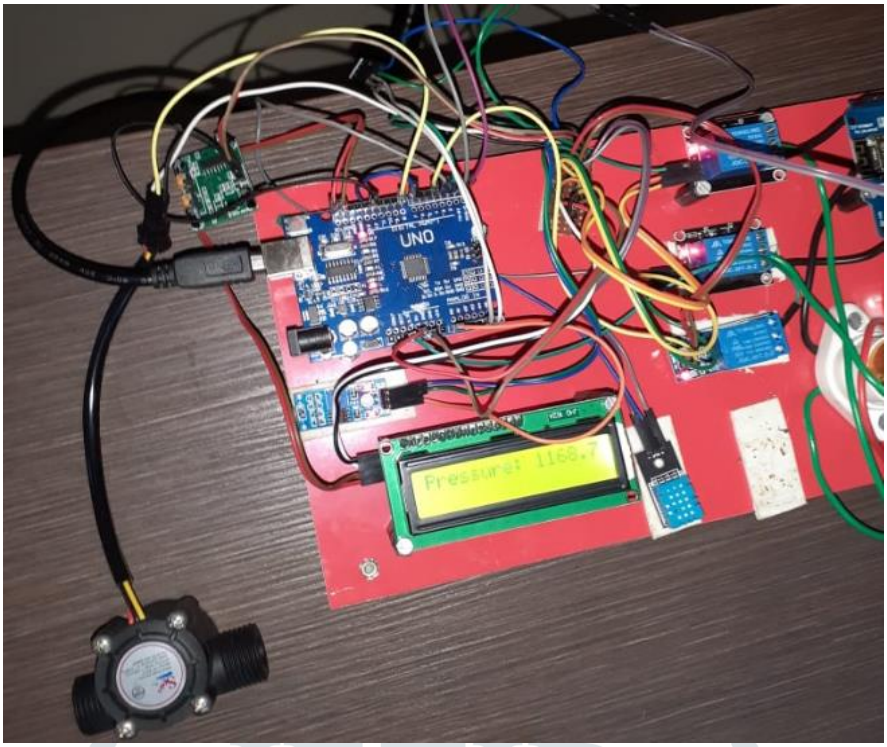

Figure: - Pressure Sensor

Pressure sensor helps to find the position of the person

IV. CONCLUSION

This paper presents a smart home monitoring and alerting system for the disabled using Natural Language Processing (NLP).the proposed system used several sensors like temperature sensor, Water flow Sensor, Pressure Sensor, Motion Sensor and LDR sensor. Using this system user can control the home equipment automatically using Wireless communication with the smartphone for people with special needs. The system can track and analyze the behavior of the residents at multiple time scales and provide reports and alerts to the caretaking staff. Motion sensor helps to detect the presence of the person in the room.

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