System to Assist Elderly to Enhance Their Independence

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***Abstract*— As the number of elderly people choosing to stay at home increases, there is also an increase of different monitoring systems to help with the security of our loved ones. The monitoring systems in the market are expensive and contain recording devices, which can cause the person to feel they do not have privacy in their own home. A non-invasive monitoring system without any recording devices was created to be placed on the house of an elderly person who wishes to age in place. The system will be connected to an Android app that has two main features. The first feature allows authorized personnel to have access to live feed data which shows the location of the person in the house and the details of each sensor, while the second will send notifications in case of an emergency.**

I. Introduction

"Aging in place" is defined as a person preferring to stay at their home as they age. As we age, the idea of giving up our independence and moving to another home or facility can come with both emotional and physical stress. This leads to nearly 90 percent of people over the age of 65 to say they prefer to live out their remaining years in their own home [1]. However, aging at home comes with many disadvantages. As people grow older their physical and mental health declines, which encourages families to send their loved ones to an assisted living facility or nursing home. Such facilities come with high monthly costs ranging from roughly $4000-$8000 [2]. This system demonstrates a low-cost alternative to monitor a person at home while ensuring their privacy. Older adults represent a vulnerable group as staying at home may turn out to be challenging when care needs to increase, particularly towards the end of their life.

Project Statement

The monitoring system will use the Internet of things (IoT) framework while using Google Firebase cloud resources to assist the elderly in their own homes despite their challenging physical and mental needs. The system will use several sensors to collect real-time data and identify various house activities by the elderly resident. Authorized users will be able to monitor the safety of a person living alone.

II. Materials

A. PIR Sensors

The PIR motion sensors (Fig 1) will be used to monitor both the location of the person as well the time spent

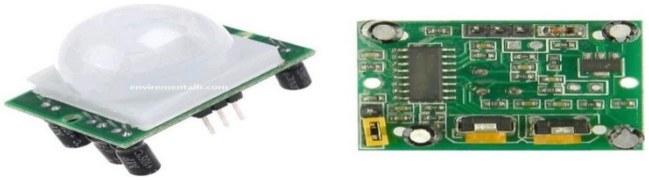

Fig 1. PIR Motion Sensor

inside a room or outside the house. The PIR sensors will be placed on the entrance of the house and the entrance of every room. The sensors used for the system did not require extra components as they were only connected to an output, power source of 5 volts, and ground.

B. Temperature Sensor

The temperature sensor (Fig 2) will be placed in different locations of the house to monitor temperature changes in the

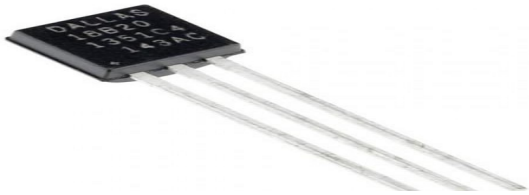

Fig 2. Temperature Sensor

house in case of a fire, or extreme low temperatures. The temperature sensor used in the system is the DS18B20 sensor. A 4.7k ohm resistor was connected between the 3.3 volts power supply and the GPIO 4 output.

C. Pressure Sensor

The pressure sensor (Fig 3) will be placed on the living room couch in order to help monitor the elderly person's health. The Force Sensing Resistor (FRS) was used to measure the pressure created by sitting on the couch. A 10k ohm resistor was connected between the ground and the output pin of the sensor. The sensor was also connected to the 3.3 volts power source.

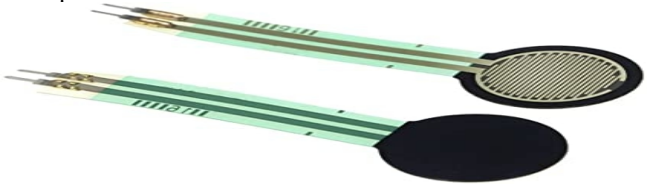

Fig 3. Pressure Sensor (Force Sensitive Resistor)

III. Integration of the System

A. Hardware Integration

The design of the monitoring system (Fig 4) will connect the PIR motion sensors, temperature sensors, and pressure

sensor to a Raspberry Pi. The Raspberry Pi will be used as the primary power source for the system to avoid battery use. The Raspberry Pi is also used to send the signals from the sensors to Google's Firebase cloud services.

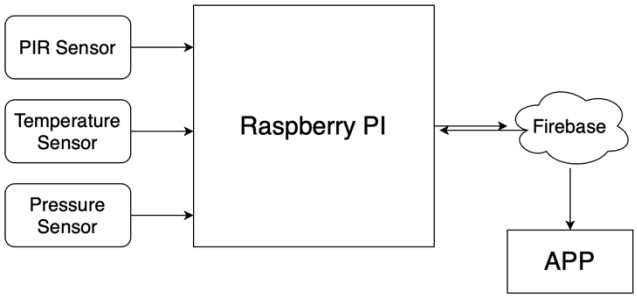

Fig. 4. System Flowchart

Google's Firebase is the intermediate process for monitoring and displaying the different sensor readings in the app. It works as a handler for connecting real-time data of the embedded sensors, collaborates with a cross-platform application, and most importantly stores the data online in the Firebase database, known commonly as the Internet Cloud. The sensor readings are stored by using the URL of database which actually acts as a backend point. This unique URL of the database further helps the app to synchronize with the database.

B. App Integration

Data from the sensors will be updated in real-time in Firebase, which can be viewed in detail by using an Android App named "Enhance Living Alone." The app will display details of all the sensors as well as the resident's current location and will allow the user to set custom timers for warning and emergency notifications (Fig. 5).

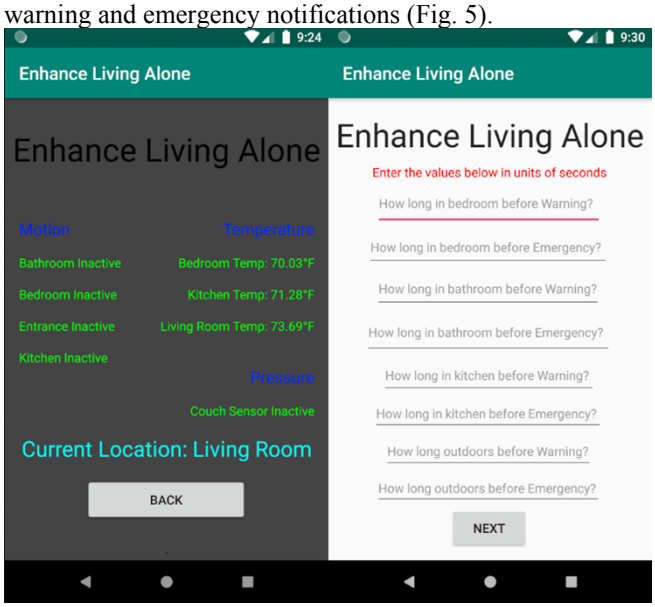

Fig 5. App

IV. RESULTS

Through the integration of the system, it was possible to send real-time data from the sensors to the Google Firebase database. With the information in the database, authorized users are able to follow the elderly resident's activities around the house. With the use of the app, the users are able to receive different notifications to warn them about unusual activity in the resident's home.

V. TESTING

The system was placed and tested in a 3' x 2' one-bedroom model house. In a real-world situation the resident being monitored would be spending minutes to hours in specific rooms before it is deemed dangerous by the app, but for demonstration purposes the app was tested with warning notifications being sent after only 10-40 seconds. Temperatures were raised and lowered to extremes by using body heat and ice. By following the same layout and replicating the code with modifications, the system can be placed in a bigger house with more rooms and more sitting places or even smaller homes.

VI. CONCLUSION

Using the three different types of sensors, we were able to create a monitoring system without any video or audio recording devices. With the PIR sensors and the FRS we were able to know the location of the resident around the house, while with the DS18B20 temperature sensor, we were able to monitor safety by ensuring the house has a safe temperature for the resident to live comfortably, otherwise notifying authorized users in case of an issue. With this system, the safety of an older adult wishing to stay in their home can be assured without taking away the resident's privacy. In the future this system can also be used for people with disabilities or health problems who wish to stay at home and enjoy their privacy.

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