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ELDERLY ACTION RECOGNITION SYSTEM

Ranjitha T R[1], Namratha Dixith R[1], Kavya M S[1], Geetha H B[1], Manasa KB[2]

[1]*UG Student, Dept. of Information Science and Engineering, NIE Institute of Technology, Mysuru, Karnataka, India.*

[2]*Assistant Professor, Dept. of Information Science and Engineering, NIE Institute of Technology, Mysuru, Karnataka, India.*

Abstract - *The elderly population is experiencing high growth in most of the countries. Without caretakers to look after them, aging parent may be susceptible to accidents. Hence, an elderly action recognition system which can automatically identify their actions and whereabouts at home and their location when they go outside is needed. The elderly action recognition system aims at providing emergency medical assistance within a few hours of occurrence.*

Keywords—Assistedliving, Outdoor positioning, IoT, Location tracking, Fall detection.

1. INTRODUCTION

According to a report of the United Nations, the ratio of elderly persons aged above 65 is growing over the years. Living with aging parents and taking care of their well-being are common practices in India. However, the high cost of living has forced majority of the Indian households to be a dual-earner families. Due to the high cost of living, both married couple have to work in order to make ends meet, leaving their aging parents at home. Leaving the elderly parents without care may create safety and health issues which worries their working children. Therefore, assisted living technology which enables the elderly's freedom of motion and whereabouts has become one of the active research field.

The main aim of this project is to develop a wearable waist belt for elderly people to monitor their actions and recognize them if they are abnormal. The actions include fall detection and their movement. In case of abnormalities in these actions and in emergency condition, notification will be sent to the caretakers.

In this project, we have designed and developed a wearable waist belt for elderly people. There are three modules in this project. They are hardware design, desktop application and android application. The hardware components are integrated to the belt. The data from these sensors is published to the cloud.

In desktop application, we can add elder person's details and set the boundary within which they have to stay. We can also assign more than one caretaker for a particular patient. The caretakers can be either family or doctor or hospital. One can also view the real time values from the sensors of the selected patient on live monitoring screen.

An android application is developed to send the notifications to the assigned caretakers in critical conditions. The notifications are sent when the person falls, moves out of the specified boundary, when the body temperature rises or drops from the normal range and when the person presses the panic button. The caretaker can also view the location of the elder person.

2. RELATED WORKS

Several studies have discussed various activity tracking. Among the methods used for the activity tracking include wearable device or smartphone. Anguita et al. used accelerometer and gyroscope in a smartphone to detect six activities, namely walking, going upstairs, going downstairs, standing, sitting and laying. The mobile phone was placed at the waist of the volunteers. The data collected from the experiment was used as the dataset for machine learning and the classifier used to determine the activities was SVM. The highest accuracy was achieved when the user placed the smartphone in the pant side-pocket. Therefore it can be observed that the holding position of the smartphone has a great impact on the accuracy of activity recognition. Since the user might not keep the smartphone in the same position, the usage of smartphone to track the activities might not be feasible. Pham et al. used distributed motion sensors; Passive Infrared (PIR) was employed to detect ambient motion which in turn helped to detect the location. Both MIMU and PIR are not accurate enough to reliably detect location. Anguita et al. used real time video monitoring in combination with sensors to check indoor location, which may cause privacy issue if implemented. The research by Nienhold et al. used wearable sensors (accelerometer,

magnetometer , gyroscope) and ambient motion sensor to track both activity and location which were then combined to detect the action of the elderly. Based on the activities, sensors were placed on the arm or leg of the patient. The raw data from sensors were collected and tested with different machine learning (ML) algorithms. The ML algorithms adopted include Naïve Bayes (NB), Support Vector Machine (SVM), Feed-forward Neural Network (FNN) and Deep Belief Network (DBN). The accuracy of each algorithm was compared. The accuracy of the detection in this experiment was over 90%. However, the types of sensor being used and the algorithms adopted are different and very much depending on the type of activities being detected. Due to the differences in the sensor setup between the activities, the dataset used for the machine learning was not consistent for different activities. The complexity of placing the sensors in the right place would be a huge obstacle for practical usage. Vepakomma et al. proposed a method to integrate both activities recognition and indoor positioning to study the actions in context of the elderly location using wrist-worn wearable's with the aid of other sensors including Global Positioning System (GPS), Bluetooth beacon, temperature, air pressure and humidity sensors. The experiment starts with data collection using sliding window based data, pre-processing and features extraction. The pre-processed data was evaluated with various Deep Learning Neural Network models and parameters with accuracy of over 90%.

From these literature reviews, it can be seen that the wearable's such as belts may be more useful because Wrist-worn wearable also has the issue of picking up false readings due to the user moving his or her hand. For instance, moving a hand back and forth may be interpreted as falling. The actions have been studied in real time in a way that does not intrude on the user's privacy and emergency notification can be sent to the relevant parties. Emergency cases include those that require immediate attention such as falling and the location.

3. METHODOLOGY

In order to reduce the false reading, a wearable device on a waist belt is developed in this project. The device consists of tilt sensor, NodeMCU, temperature sensor, panic button and GPS receiver.

The wearable device reads the raw data from the sensor and push the raw data to the Message Queuing Telemetry Transport (MQTT) server. Similarly, the latitude and longitude values are read from GPS receiver and pushed to the MQTT server. Next, the results of the location and motion are analyzed to derive the action of the elderly.

Fig - 1 shows the prototype of hardware device and Fig - 2 shows the system design.

Fig – 1: Prototype of hardware device.

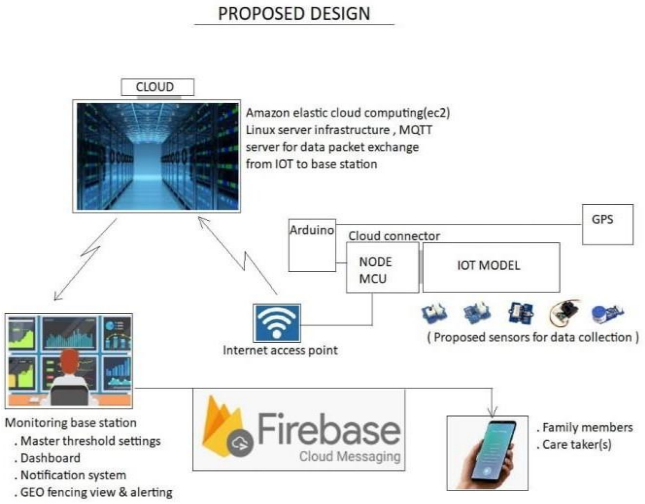

Fig – 2: System Design

3.1 DATASET COLLECTION

In this project, there are 5 different types of data that comes from sensor. They are latitude, longitude, temperature, title sensor value and panic button value.

Latitude and longitude value are from GPS receiver that represents the present location of the elderly person. Temperature value represents the body temperature of the elderly person. Tilt sensor's default value is 1. In case of emergency i.e, when the elderly person falls, the value changes to 0. Similarly, the default value of panic button is 0 and when elderly person presses the panic button, the value changes to 1. The below image shows the wearable device prototype.

3.2. DESIGN AND IMPLEMENTATION:

When the elderly person wears the device, his/hers location, body temperature, tilt sensor value and panic button values can be monitored in serial monitoring. These values are displayed in time difference of 1sec.

In our project, there are 4 different emergency cases, they are:

1. Fall down of elderly person
2. Increase or decrease in body temperature
3. Elder is lost or if they are far from their home
4. When elderly person presses panic button.

During the above emergency cases, a notification is sent to the caretaker, family member and family doctor.

To notify the emergency cases, we are using an android application which uses a FCM Token to send notification. Notification contains the location and cause of emergency. And the notification that is send to doctor or hospital also contains the family contact number.

We have also developed a desktop application for serial monitoring. The emergency cases can also be viewed on desktop application.

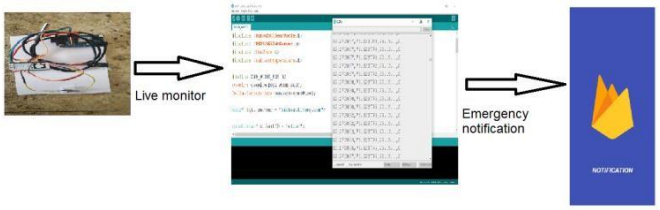

Fig – 3: Design for sending a notification

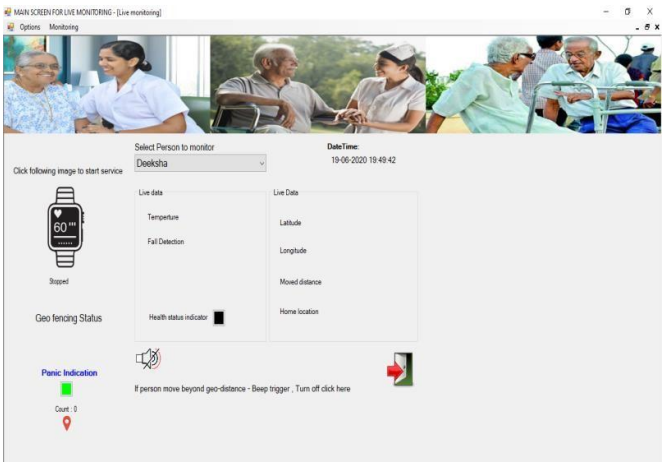

Fig - 4: Desktop application for live monitoring

The below fig - 5 shows the flowchart of working of our project. The various values that comes from hardware device are stored in cloud and with the help of IOT application those values are fetch and feed to desktop application.

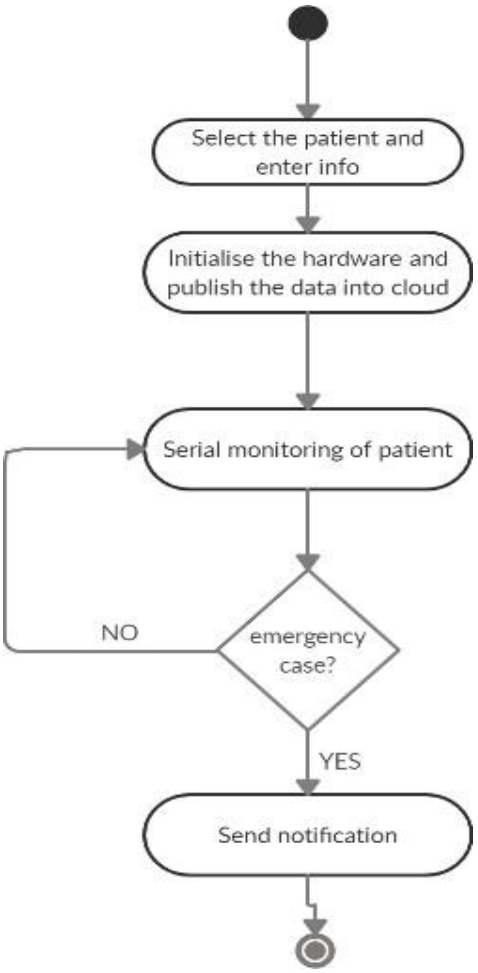

Fig – 5: Flowchart of overall working

4. EXPERIMENT AND RESULTS

For evaluation of algorithm, environment used are Window operation system. The device is also equipped with processor Intel core i3 and RAM 8GB.

5. CONCLUSION

The elderly action recognition system based on outdoor location and fall detection has been successfully implemented and tested in home environment. The combination of

technologies including IoT using sensors, Cloud Database (SQL), live monitoring and push notification through FCM have been demonstrated to simulate the monitoring of activities. The system showed a high accuracy.

In this project, a wearable waist belt is developed as it is able to produce better results. Also, a desktop application is developed for live-monitoring of the elder person and an android application to notify the caretakers in case of emergency along with the cause and their current location. The system still warrants more research on how to use the results for healthcare purposes in order to detect early symptoms of age-related illness based on the time, motion as well as the behavioral pattern of the elderly. However, the high degree of accuracy and ease of usage of the system show great promise in many forms of application related to elderly healthcare.

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