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Elder Assist - An IoT Based Fall Detection System

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Abstract: *With the ever-growing population, there is an urgent need for the development of fall detection systems that can help individuals in falling which is one of the most damaging events elderly people may experience. Thanks to the rapid development of sensors and the development of the Internet of Things (IoT), human-computer interaction using sensor fusion has been considered an efficient method to deal with the problem of fall detection and can help in aiding immediately. In this paper, we discuss about a solution to this problem by proposing an IoT based device which can be implemented on a walking stick which is used by elderly people. This device is made using sensor networks and IoT. The development of technology requires the innovation of a device that can be used to help the blind & senior citizen as a road guide. The project describes walking stick. Senior citizen & blind people must ask guidance to reach their destination. They must face more struggles in their life daily life. Using this stick, a person can walk more confidently. This stick detects the object in front of the stick and gives response to the user. So, the person can walk without any fear. This system will be best solution to overcome their difficulties. We are going to upgrade the project by increasing its application. In this project, we are going to use ultrasonic sensor to sense any obstacle. The smart walking stick helps people to perform navigation and to do their work easily and comfortably. In smart walking stick, the object is detected with the help of ultrasonic sensor which detects the distance between object and the stick. If any obstacle comes in front of stick, he/she can know about the obstacle by indication.*

Keywords: Internet of things (IoT), Accelerometer, Fall Detection System, Sensors Networks, Assistance

I. INTRODUCTION

This study proposes improved technique for designing a smart stick to help visually impaired people for their navigation. In this system, the ultrasonic sensors are used to detect obstacles by using ultrasonic waves. By sensing the obstacles, the sensor passes the received data to the microcontroller. The microcontroller processes the data and calculates if the obstacle is close enough to the person. If the obstacle is not close to the microcontroller, the circuit does not do anything. If the obstacle is close enough to the microcontroller, it sends a signal. Falling is one of the most damaging events elderly people may experience. With the ever-growing population, there is an urgent need for the development of fall detection systems that can help individuals in such cases. Thanks to the rapid development of sensors and the development of the Internet of Things (IoT), human-computer interaction using sensor fusion has been considered an efficient method to deal with the problem of fall detection and can help in aid immediately. In this paper, we offer a literature survey of labour conducted on elderly fall detection using sensor networks and IoT. Although there is various existing solution that focuses on fall detection with sensors, such as wearable devices and depth cameras, the performance of these solutions are still not satisfying as high false alarms is high with them. Falling is a serious issue and one of the major cause of injuries among elderly people. Thus, there is a need to develop systems that can automate the detection of falls and provide an alarm in such cases of emergency. This paper presents an IoT based fall detection system that is handy, easy to carry and can be fitted on walking sticks. This device can monitor the movements of patients and can recognize the motion of fall, and automatically sends an alarm to the caretakers. Creating this device can address the serious problem of falling or slipping in senior citizens so that proper timely medical treatment can be provided in case of emergency when the alarm is triggered.

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II. Literature Survey

Various researchers have done excellent work on Fall Detection Systems. Propositions of a few authors are discussed in this section with some of their drawbacks as well. [1] Stefano Abbate et al. have proposed a fall detection system developed by using Smartphone's in-build accelerometer sensor. The plat- form is provided via a mobile application. Since it is application based the cost of development is kept on the lower side. The application interface is not suitable for senior citizen as they can find it difficult to operate. Yuxi Wang et al. have developed WiFall[2] that employs the time variability and special diversity of Channel State Information (CSI) as the indicator of human activities. They implement WiFall on laptops equipped with commercial 802.11n NICs. There is no need of additional hard- ware or any physical device, with a high accuracy of detection rate. Although since it is implemented on a laptop it is not accurate for senior citizens as they can find it difficult to implement. In [3], Lucio Ciabattoni et al. have developed a Fall Detection Algorithm by using a deep learning approach and a low-cost mobile robot with an RGB camera. Detection is done by video stream and a Deep Learning approach; if a fall is detected, a photo is acquired, and a pre- registered audio message asks the user how he is. Captured are sent to a Telegram Bot (TB) in order to alert family members or caregivers. However, in case if the subject is injured or fainted by the fall, he cannot communicate with bot. In [4], Adrián Núñez-Marcos A vision-based solution using Convolutional Neural Networks to decide if a sequence of frames contains a person falling. Here Camera based detection approach to check if the subject is standing or falling. [5] Smriti Bhandari et al. used the Shi-Tomasi algorithm for fall detection and tracked by Pyramidal Lucas-Kanade algorithm. The speed and direction of motion is computed along with maximum displacement of interest point. High accuracy is achieved by this approach but due to usage of camera the subject movement is limited. Hanghan Liang [6] et al. used Lifting wavelet trans- form (LWT) provides computational efficiency suitable for real-time low power devices such as wearable sensors for hu- man fall detection. LWT is combined with support vector machine (SVM) Performance of the Haar and Biorthogonal 2.2 wavelets were compared with the time domain feature of root-mean square acceleration using a human fall dataset. Here high rate of detection is achieved by this system the initial cost of investment is on higher side.[7] Kanitthika Kaewkannate et al. have selected and compared the four most popular wristband style wearable devices currently on the market (Withings Pulse, Misfit Shine, Jawbone Up24, and Fitbit Flex). The comparison provides an in-depth review of popular fitness wearable devices. In [8], Na Lu et al. have developed a three-dimensional convolutional neural net- work (3-D CNN) based method for fall detection, which uses video kinematic data to train extractor and circumvent the requirement for large fall dataset of deep learning solution. In [9] Diana Yacchirema et al. developed an IoT based wearable device using low-power wireless sensor networks, smart devices, big data and cloud computing for data analysis. This had a good solution with data accuracy. The data generated can be further used to analysis the impact of fall. In [10], Falin Wu et al. developed a fall detection system based on a wearable device. The system monitors the movements, recognizes a fall from normal daily activities by an effective quaternion algorithm, and automatically sends request for help to the caregivers with the patient's location. Here wearable device with an GSM module which gives instant notification to caretake in case of fall detectionn easy way to comply with the Journalpaper formatting requirements is to use this document as a template and simply type your text into it.

III. Related Work

Threshold-based systems is been widely research field. Some researches show us the ability to detect falls and classify falls from ADLs and near-fall conditions. An algorithm that is based on the first differences and first derivatives of the sum of accelerometer readings along all their axis X, Y, and Z directions is described. This algorithm is in real-time, reliable and was capable of distinguishing ADLs movements from actual falls movement. A system with a triaxial (X, Y, Z-axis) accelerometer and proposes an algorithm based on thresholds of sum acceleration and rotation angle information. This combines threshold values of acceleration with rotation, to provide a conclusion whether a fall has taken place or not.

IV. Proposed System

The stick uses sensors mounted on the stick so that it will assist in carrying out daily activities, the ultrasonic sensor is mounted, and it aims to make the position of ultrasonic sensor will be in a straight position to the detection of objects in front of it. The Wifi module will provide coordinates and later it will be forwarded to the android device. Overall system testing involves all components in the smart stick system that has been well integrated, to find out all the components have

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worked we can see the results of reading all components on the serial monitor such as ultrasonic sensors, fall detection sensor, Wi-fi sensor. The initial step of testing is by providing a voltage source for the smart stick using a USB cable connected to the laptop. When the smart stick has got a voltage source, the next step is to upload the program with the help of the Arduino Sketch software. Next, do a test run on Wifi Module is used send a GPS coordinate point. If the message received has no coordinates (coordinate point 0) then wait for a while until the GPS module is connected to the satellite. The next process is to test the button/switch, when the button is pressed it will not send a GPS coordinate point because we consider it falls by mistakenly. Furthermore, tests on an ultrasonic sensor as a barrier and obstacles object detector; in this test the sensor can detect objects. If the ultrasonic sensor detects an object then the signal is generated. One more feature added with this system that is Reminder for Medicine. So that if user forgets to take medicine then there is always android application to remind.A device is placed on the walking stick. The system can detect the elderly's falling by sensor. Then it will get the elderly's geographic position and send a fall alarm to application via necessary sensors and modules. So, the elderly who has fallen can get timely help to minimize the negative influence. The recognition feature has significant importance in improving the success rate of fall detection. The device will in constant motion with its subject. As soon as fall is detected, An alarm will get triggered and the GPS Coordinates of the subjects will be send to android app. Another feature is Obstacle Detection, when any obstacle is detected in front of walking stick then it will give indication about obstacle, so that user will be aware about that obstacle. Here obstacle can be anything like vehicles, wall & etc.The architecture of the wearable system is described in Figure 1 below. A wearable device is placed on the subject's waist. The system can detect the elderly's falling by acceleration analysis using an accelerometer. Then it will get the elderly's geographic position and send a fall alarm short message to caregivers via necessary sensors and modules via the GSM. So, the elderly who has fallen can get timely help to minimize the negative influence. The recognition feature has significant importance in improving the success rate of fall detection. Information required to detect linear movements such as (e.g., displacement, velocity, and acceleration) and angular movements (e.g., angle, angular velocity, and angular acceleration) could be obtained by usage of necessary sensors. Besides these, frequency domain parameters could be extracted from basic sensor measurements by techniques such as FFT and wavelet. For a single triaxial accelerometer application, accelerations and derived angular parameters could be used as recognition features. The wearable device will in constant motion with its subject. As soon as fall is detected, An alarm will get triggered and the GPS Coordinates of the subjects will be recorded via the GPS module in device. This data of the coordinates and the fall notification both will get transmitted via a GSM network and a notification will be send to subject's caretaker to inform him about the emergency.

4.1 System Architecture

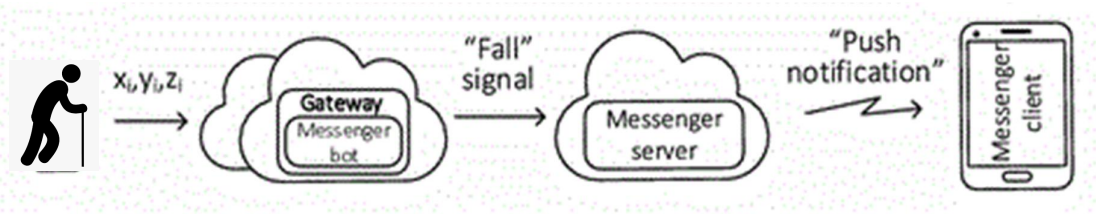

Figure 1: System Architecture

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4.2 Device Flowchart

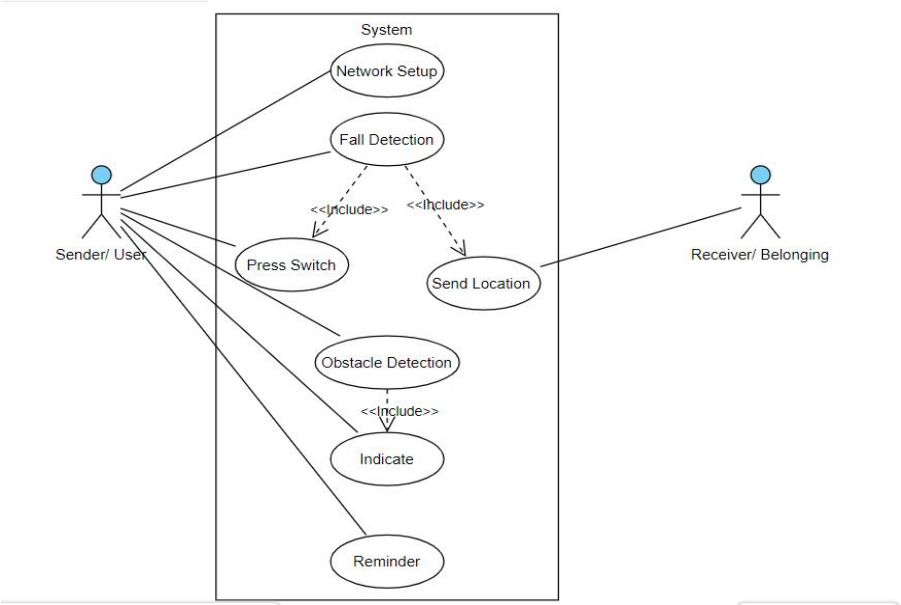

Figure 2: Device Flowchart

V. RESULT

Login Page:

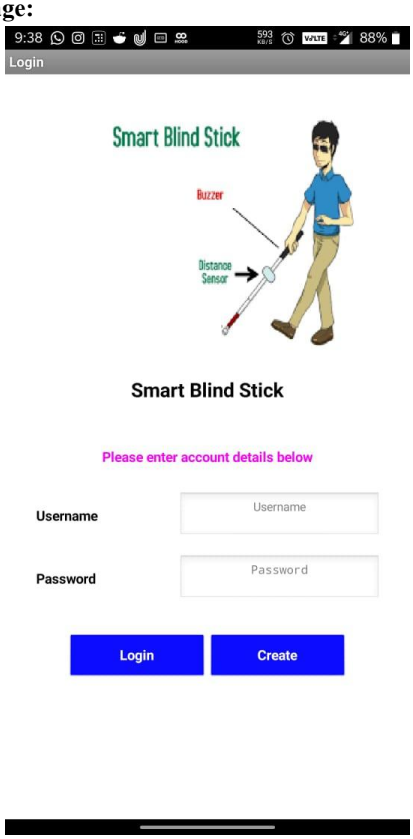

Figure 3: User Login Page

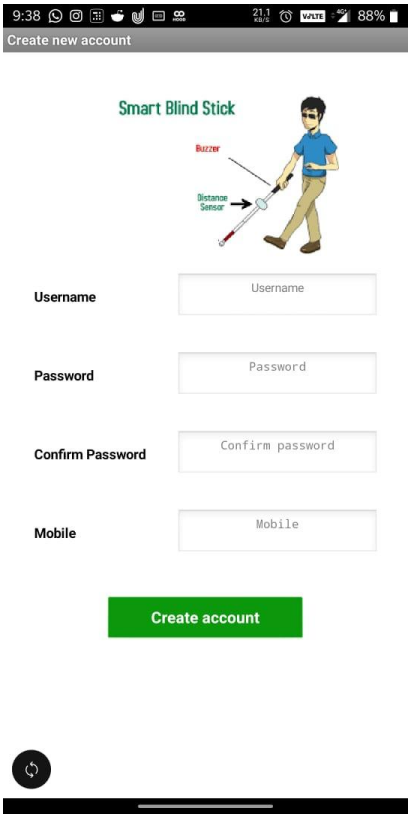

Figure 4: Create new account Page

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Medicine Reminder:

Figure 5: Set Time

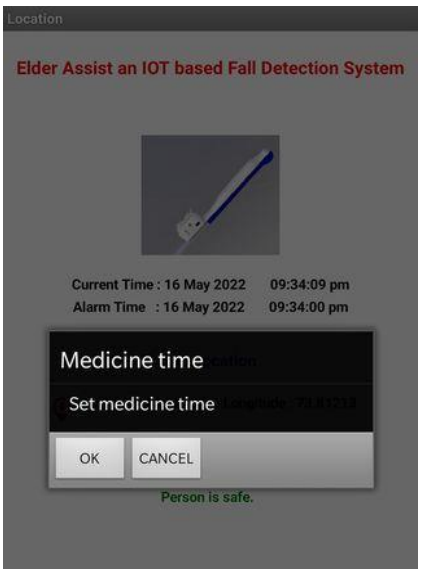

Figure 6: Timer Set Confirmation

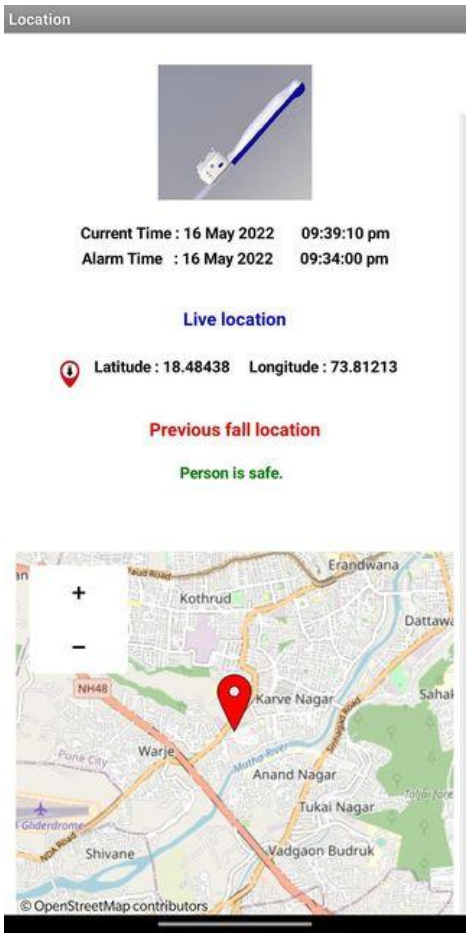

Figure 7: Fall Live Location

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VI. CONCLUSION

This research paper is development of a fall detection & obstacle detection system. Using android application, user will remind to take medicine on time. There is no special requirement of the device's mounting orientation. The system has low power consumed hardware design and is compact enough to hold around. The hardware and the software both are suitable to move around. It is worth mentioning at this point that the aim of this study which is the design and implementation of a smart walking stick for the people has been fully achieved. The Smart Stick acts as a basic platform for the coming generation of more aiding devices to help the visually impaired to navigate safely both indoor and outdoor. It is effective and affordable. In a developing country like India, there is a need for a cost-effective solution so that most of the people can have an effective product as proposed in this research paper.

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