Design and Implementation of Intelligent Mobile Browser on a Device Pose Recognition

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Abstract:- **The device pose can be identified with the help of MEMS sensors, which already embedded in the smartphone. In this work sensors like accelerometers, gyros, and orientation measurements can be utilized to retrieve the information about the mode of the device. In this paper proposed an intelligent mobile browser (ibrowser). After the device pose identification, the details can collect to a mobile browser called ibrowser (Intelligent mobile browser). The ibrowser can intelligently give recommendations like font size and brightness changing. The identified situations communicated with the web applications so that it is easy to make changes on the device like increase the font size if the user device in walking mode or travelling mode and increase the brightness if the density is poor. Hence it improve the user experience in low light situations, walking sessions, travelling mode, etc.**

Keywords:- MEMS Sensors, Device pose Recognition, I Browser, and AI..

I. INTRODUCTION

Modern smartphones contain motion sensors, such as accelerometers and gyroscopes. These sensors have many useful applications. MEMS are microscopic integrated devices that are a combination of electronics, electrical and mechanical elements, all working together for a single functional requirement using a technology called Microsystems Technology (MST).They are small, light and cheap sensors, whose spread is continuously growing in several sectors [1].

Accelerometer is integrated in the smart phone by most of the mobile phone manufacturers in recent years, since its small size and low cost characteristics. According to Newton's law of motion, the acceleration and movement time can calculate the displacement of the moving object. Because the MEMS accelerometer has the advantages of high sampling rate, high sampling precision and off-line operation, it can accurate the precise location of an object.

All smart-devices (phone, tablet, clocks) have an increasing number of embedded sensors that measure motion, orientation and several environmental parameters. As a result, smart-devices could be considered very powerful mobile sensor platforms These sensors are enabling new applications across a wide variety of domains, such as navigation, healthcare, IoT, safety, environmental monitoring and they are giving rise to a new area of research called mobile phone sensing. The outputs of smart-devices sensors are raw data with a high rate that directly provide information on a physical quantity (physical or hardware sensors) or that compute a quantity estimate by processing several measure sources (virtual or synthetic or software sensors). Three broad sensor categories could be considered: motion, environmental and position sensors. The first category includes physical sensors as accelerometers and gyroscopes, which can measure acceleration and angular velocity, while, as virtual sensors, gravity, linear acceleration, step detector, and counter. Environmental sensors (barometers, photometers, and thermometers) measure various environmental parameters, such as ambient air temperature and pressure, illumination, and humidity. The last category refers to sensors providing the physical position of a device like GNSS, magnetometers and proximity sensor; the device orientation is usually provided by a virtual sensor, which is based on a fusion of accelerometers, gyroscopes and magnetometers measurements.

The paper is organized as follows. Section II describes the literature survey of the previous methods used on device pose recognition, intelligent access and retrieval of data on different types. Section III illustrates the proposed system. Section IV discusses performance evaluation. Finally, section V concludes the paper with future work.

II. RELATED WORKS

MEMS sensors, like accelerometers, gyroscopes, and magnetometers, are spreading in a wide range of applications, because of their small size, cheapness and increasing performance. For instance, smartphones are currently equipped with this kind of sensors, which could be used to improve the user experience of the phone itself or the navigation functionalities. There have been several studies about the communication between the users and devices. In this section, we explain about the previous methods on device recognition, simulations, and web accesses.

Accelerometer and gyroscope sensors embedded on a single board along with a distance-based pattern recognition algorithm is presented in [2]. Here it is used for accurately identifying basic movements for possible application in gaming using a mobile platform. This technology applied in track and monitor the movements of elderly people to guarantee they are getting up, to detect falls, or to monitor electric wheel chairs. Due to the design defects of the acceleration sensor, the error of measurement results is very large. In[5], by analyzing the two main errors of measurement noise and the drift error, the corresponding error elimination method was proposed. Which can improve the accuracy of the MEMS accelerometer in measuring distance. Deep learning techniques are adapted to recognize human activities on the basis of the data extracted from accelerometer and gyroscope sensors [6]. This paper explores deep, convolutional and recurrent approaches across three representative datasets that contain movement data captured with wearable sensors. The paper [7] use a random forest ensemble classifier to recognize users using data from phones embedded accelerometer sensors. It proposed a system using the random forest classification model for the person recognition using smartphones accelerometer data. In [8], analyze how well sensor fingerprinting works under real world constraints. Here developed a highly accurate fingerprinting mechanism that combines multiple motion sensors and makes use of inaudible audio stimulation to improve detection. The recognition of hand gestures is a very interesting research topic[9]. This paper describes the implementation of a visual-based recognition system on a embedded computer for 10 hand poses recognition. Hand detection is achieved using a tracking algorithm and classification by a light convolutional neural network.

The combination of the intelligent mobile device and the web client is used in [10]. [11] Introduces a novel Mobile Web Browser based on the principles of the Ambient Intelligence (AmI). Web browser uses the Smartphone's hardware elements as sensors and microphones to capture the environmental information, which will be intelligently analyzed to detect events and other situations. The identified situations will be communicated to the web application, so that appropriate adaptation are made and there by improve the user experience. Situated Information Filing and Filtering (SIFF) for information management [12] based on a user's situation which consists of sensitive surroundings such as the location and time and the user activities for modeling the user's personal information space. The paper [13] introduce a novel Mobile Web Browser based on the principles of the Ambient Intelligence (AmI).

III. A CLOSER LOOK AT MOTION SENSORS

In this section we briefly take a closer look at motion sensors like accelerometer and gyroscope that are embedded in today's smartphones. This will provide an understanding of how they can be used to identify the device orientation through the use of an accelerator, a small device made up of axis-based motion sensing. Accelerometer and gyroscope sensors in modern smartphones are based on Micro Electro Mechanical Systems (MEMS). STMicroelectronics and InvenSense are among the top vendors supplying MEMS-based accelerometer and gyroscope sensor to different smartphone manufacturers. Traditionally, Apple, Samsung favor using STMicroelectronics motion sensors, while Google tends to use InvenSense sensors. Light sensors measure illuminance, which can be used to measure more than the brightness of a light source. Because the illuminance decreases as the sensor moves away from a steady light, the light sensor can be used to gauge relative distance from the source.

A. Accelerometer

Accelerometer is a device that measures proper acceleration. Proper acceleration is different from coordinate acceleration (linear acceleration) as it measures the g-force. For example, an accelerometer at rest on a surface will measure an acceleration of $g = 9.81ms^2$ straight upwards, while for a free falling object it will measure an acceleration of zero. MEMS-based accelerometers are based on differential capacitors. Figure 1 shows the internal architecture of a MEMS-based accelerometer. As we can see there are several pairs of fixed electrodes and a movable seismic mass. Under zero force the distances d_1 and d_2 are equal and as a result the two capacitors are equal, but a change in force will cause the movable seismic mass to shift closer to one of the fixed electrodes (i.e., $d_1 \neq d_2$) causing a change in the generated capacitance. This difference in capacitance is detected and amplified to produce a voltage proportional to the acceleration. The slightest gap difference between the structural electrodes, introduced during the manufacturing process, can cause a change in the generated capacitance. Also the flexibility of the seismic mass can be slightly different from one chip to another. These form of minute imprecisions in the electro-mechanical structure induce subtle imperfections in accelerometer chips.

B. Gyroscope

Gyroscope measures the rate of rotation (in $rads^{-1}$) along the device's three axes. MEMS-based gyroscopes use the Coriolis effect to measure the angular rate. Whenever an angular velocity of $\hat{\omega}$ is exerted on a moving mass of weight m, and velocity $\hat{v}$, the object experiences a Coriolis force in a direction perpendicular to the rotation axis and to the velocity of the moving object (as shown in figure 2). The Coriolis force is calculated by the following equation $\hat{F} = -2m\hat{\omega} \times \hat{v}$. Generally, the angular rate ($\hat{\omega}$) is measured by sensing the magnitude of the Coriolis force exerted on a vibrating proof mass within the gyro.

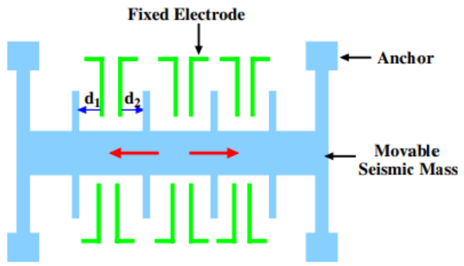

Figure 1 : Internal architecture of a MEMS accelerometer.

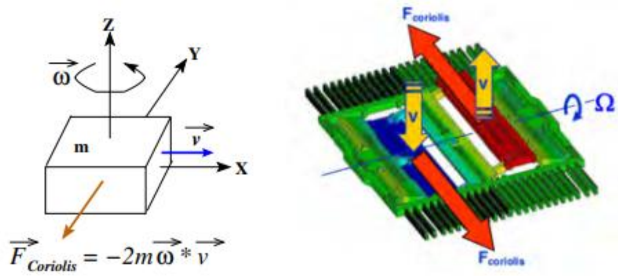

Figure 2 : MEMS-based gyros

C. Light sensor

The intensity of light is inversely proportional to the square of the distance. This means that as the distance from a light source increases, the intensity of light is equal to a value multiplied by $1/d^2$,. Android's light sensor measures ambient light in "lux" units, which is the intensity of light as perceived by the human eye. The lux value reported by a sensor can vary across devices, so if your application requires consistent values then you may need to manipulate the raw data before using it in your application.

1V. PROPOSED SYSTEM

We have discussed many dissimilar methods related to our paper. Methods like technique for the communication in between the user side and server side, Activity recognition, Interaction with the mobile devices through cloud services, intelligent recommendations for the users as intelligent search engine, intelligent browser assistant, and intelligent agent so on.

This paper proposes the identification of the device pose with the help of mobile embedded sensors and additionally introduces an intelligent Mobile Browser. It helps to detect the characteristic findings. Firstly, identified the state of the device with the help of MEMS sensors. After the device mode detection the browser can track the user's device mode or the state of the user's device with the help of sensors which is already implemented in the smart devices. Fig:3 showing the methodology of the entire process. For that process to take place the two steps are:

1. **Walker identification and device pose recognition**

The proposed approach is based on the assumption that a set of MEMS sensors typically installed in smartphones can be used to capture the walking behavior of the device user and this information can be used to identify him among different users in real-time (i.e., during walking sessions).

2. **Improve user experience**

The proposed solution introduces a novel intelligent Mobile Web Browser. This Web browser uses the Smartphone's sensor data, which will be intelligently analyzed to detect events and other situations. The identified situations will be communicated to the web application, so that appropriate adaptation are made and there by improve the user experience.

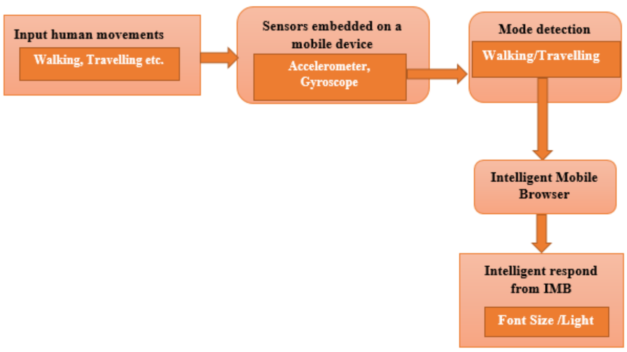

Figure 3: Methodology of the proposed system

A. CONCEPTUAL SCHEME

The proposed approach is composed of several elements such as sensors embedded in a device, intelligent mobile browser etc. The centerpiece is the responsive intelligent web browser, which captures information from the environment (with the help of sensors) about the user state. The physical state detect intelligently.

Sensors can obtain a measure of a parameter in a particular moment. Thus, to determine whether the current state has changed, it is important to analyze the change in values in the different states, since these are the ones that initialize the process of adaptation of Web applications. Based on needs, we have considered that a good design decision is to implement an intelligent browser concept. We can able to determine if there is a change in value from any of the states.

Figure 4: Different states of devices.

Figure 4 represents 3 different state of phone, according to that the acceleration value will change its axis value as shown in Table 1.

Table 1: Acceleration value of 3 axis at 3 state

State	1	2	3
Acceleration value on 3 axis	X-axis: 9.42238	X-axis: 0.2891	X-axis: 0.45370123
	Y-axis: 0.37349546	Y- axis: 9.9550905	Y-axis: 0.21428105
	Z-axis: 0.5279215	Z-axis: 0.077811554	Z-axis: 10.131064

B. INTELLIGENT MOBILE BROWSER

The proposed concept completed through the following modules.

Module 1: Standard Web Browser .

Using Netbean IDE 8.1 completed this part. When you receive the source code of the website, performs processing initial. The initial page is registering part. It is done by giving the mobile number and password. This is the process to track the particular person. After the registration part completed it go to the browser. The source code of the registration part shown in figure 5.

The visual representation of the source code of the Web is loaded into a graphical controller called WebView (based in Webkit). The interpretation of the source code of the Web is based on standards and is practically the same as the made by commonly used web browsers (Chrome,Firefox, etc.).

```
try{

    Class.forName("com.mysql.jdbc.Driver");
      Connection con = DriverManager.getConnection("jdbc:mysql:
      Statement stmt = con.createStatement();

      String username = request.getParameter("Mobile");
      String password = request.getParameter("Password");

    System.out.println("username=" + username);
      System.out.println("ps=" + password);

     // JsonObject jobj = new JsonObject();


    String query = "insert into login(username,password,type)val

    System.out.println("query=" + query);
```

Figure 5: Registration part

Module 2:

The second module is accomplished by the sensor data collection. The sensors considered as features are the accelerometer, the gyroscope triads (both physical sensors), and the orientation (virtual sensor, i.e. roll, pitch and yaw angles). Analysis of the data captured by the sensors it is a mathematical and statistical task. The functions of analysis use methods included in the Apache library Commons Math. The location tracking process is explained in Fig 6 .

```
try {
    locationManager = (LocationManager) mContext
            .getSystemService(LOCATION_SERVICE);

    // get GPS status
    checkGPS = locationManager
            .isProviderEnabled(LocationManager.GPS_PROVIDER);

    // get network provider status
    checkNetwork = locationManager
            .isProviderEnabled(LocationManager.NETWORK_PROVIDER);

    if (!checkGPS && !checkNetwork) {
        Toast.makeText(mContext,  text: "No Service Provider is available", Toast.LENG
    } else {
        this.canGetLocation = true;
```

Figure 6: code for location track

Module 3:

This is the intelligent mobile browser part. As the sensors collected data (Eg: motion, light, location tracking etc.) the data collected by server and after that the intelligent browser can automatically respond according to the situation. If the light intensity is less, it can automatically increase the light. Font size can also change.

V. RESULT ANALYSIS

The implemented browser respond accurately according to the user recommendation. It automatically increasing the font size while the user is in walking mode. Similarly, the intensity of light also adjusting according to the user behavior. The first part is the registration part. Before entering into the browser there will be a registration part by entering user mobile number and password as shown in figure 7. If the the data field is not registered who cannot enter into the intelligent browser or who cannot accessed by i-browser.

Figure7: login page

The registered person can enter into the intelligent browser page shown in figure 8. It also protected by theft protection mechanism (shown in figure 9). It ensuring that browser is secure from people are out there trying to find ways to steal data.

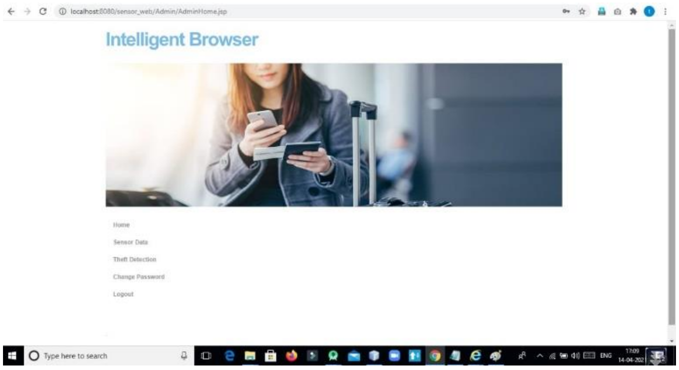

Figure 8: Home page of i-browser

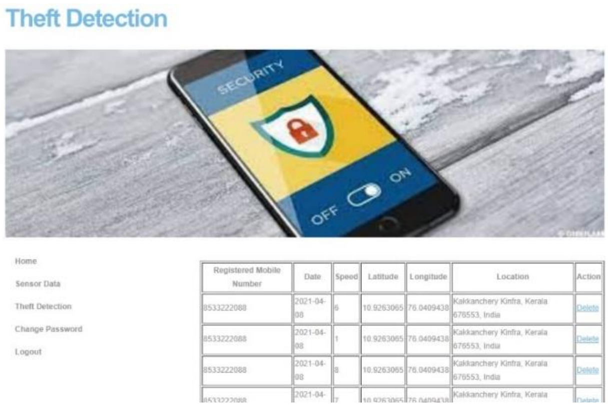

Figure 9: Theft protection page

The sensor data collected by browser also included in the page. It shown in figure 10. Sensor readings are only accessible by a visible web page, i.e., when the user is actually interacting with it.The sensor specifications reached candidate recommendation maturity level, the feedback from web and browser is most accurate. The most important part of this project is shown in figure 11. Whenever the user is in walking mode or travelling mode, the user can read it most conveniently through the automatic respond from the i-browser as shown in figure 11.

Figure 10: Sensor data page

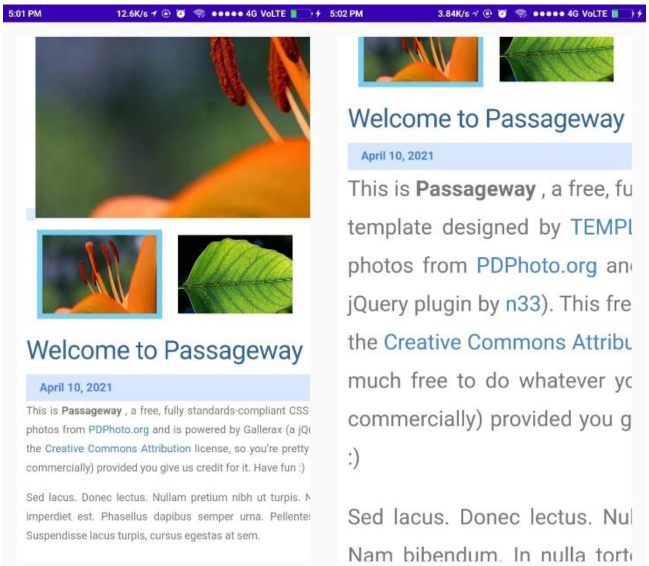

Figure 11: font size normal shown in first part, increased font size shown in second part

V. CONCLUSION

In this paper proposed identification of device pose and an intelligent recommendation on it. The proposed solution aims to improve the efficiency and performance of Smartphones. The solution also be adequate and simple to implement, so that in this way it does not require excessive cost of implementation or learning for the implementation. According to the device pose, the browser can automatically respond as increasing the font size, brightness (during travelling walking mode). For the proposed system a web application is used in both server side and user side. According to the state or pose of the device, the web application show the result. We utilize commercial database systems as storage systems to form our system stable and cost-effective.

REFERENCES

[1] R. Bogue, ”Recent developments in MEMS sensors: A review of applications, markets and technologies," Sensor Rev., vol. 33, no. 4, pp. 300_304, Sep. 2013.

[2] A. Kailas, "Basic human motion tracking using a pair of gyro + accelerometer MEMS devices," 2012 IEEE 14th International Conference on e-Health Networking, Applications and Services (Healthcom), Beijing, China, 2012, pp. 298-302, doi: 10.1109/HealthCom.2012.6379424.

[3] Claudia Carpineti, Vincenzo Lomonaco, Luca Bedogni, Marco Di Felice, Luciano Bononi,” Custom Dual Transportation Mode Detection by Smartphone Devices Exploiting Sensor Diversity”, Oct 2018.

[4] S. Wu and H. Wu, "The Design of an Intelligent Pedometer Using Android," 2011 Second International Conference on Innovations in Bio-inspired Computing and Applications, Shenzhen, China, 2011, pp. 313-315, doi: 10.1109/IBICA.2011.83.

[5] R. Zhang, X. Liu and Z. Qu, "The Research of Distance Measurement Method Based on Mobile Phone MEMS Accelerometer," 2016 8th International Conference on Intelligent Human-Machine Systems and Cybernetics (IHMSC), Hangzhou, China, 2016, pp. 374-378, doi: 10.1109/IHMSC.2016.131.

[6] Nils Y. Hammerla, Shane Halloran, Thomas Ploetz,” Deep, Convolutional, and Recurrent Models for Human Activity Recognition using Wearables”, Apr 2016.

[7] Thingom Bishal Singha, Rajsekhar Kumar Nath, A. V. Narsimhadhan,” Person Recognition using Smartphones' Accelerometer Data”, Nov 2017.

[8] Anupam Das, Nikita Borisov and Matthew Caesar,” Tracking Mobile Web Users Through Motion Sensors:Attacks and Defenses”, https://www.researchgate.net/publication /316906732 _Tracking _Mobile _ Web_Users_Through_Motion_Sensors_Attacks_and_Defenses, January 2016.

[9] D. N. Fernández, "Development of a hand pose recognition system on an embedded computer using Artificial Intelligence," 2019 IEEE XXVI International Conference on Electronics, Electrical Engineering and Computing (INTERCON), Lima, Peru, 2019, pp. 1-4, doi: 10.1109/INTERCON.2019.8853573.

[10] F. Tianxiang, C. Gang, P. Wenxin and Z. Yifan, "A Mobile Intelligent Reading Teaching Annotation System," 2019 14th International Conference on Computer Science & Education (ICCSE), Toronto, ON, Canada, 2019, pp. 114-117, doi: 10.1109/ICCSE.2019.8845350.

[11] D. Shi and L. Zhang, "Design and Implementation of Intelligent Construction Engineering Information Management System Supporting Mobile Platform," 2019 International Conference on Smart Grid and Electrical Automation (ICSGEA), Xiangtan, China, 2019, pp. 497-500, doi: 10.1109/ICSGEA.2019.00119.

[12] M. Hirakawa, P. Hewagamage and T. Ichikawa, "Situation-dependent browser to explore the information space," Proceedings. 1998 IEEE Symposium on Visual Languages (Cat. No.98TB100254), Halifax, NS, Canada, 1998, pp. 108-115, doi: 10.1109/VL.1998.706153.

[13] Jun Xiao, Minjuan Wang and W. N. Jason, "The design and implementation of a cloud-based intelligent learning (C-iLearning) system," 2012 International Symposium on Information Technologies in Medicine and Education, 2012, pp. 417-421, doi: 10.1109/ITiME.2012.6291332.