Critical Review of Pedestrian Safety Mechanisms for Mobile Phone Users

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ABSTRACT: Now a day's use of the Smartphone is increased while walking it may unfold disaster for pedestrian mobile phone users. For pedestrian safety, various systems detect various hazards like detecting incoming vehicles by listening background noise or through background camera image, GPS sensor to identify pedestrian in-street. But to address change of ground surface such as stairs, platforms is a challenging task because inaccurate detection of this types of hazards causes a dangerous accident. A system like InfraSee, UltraSee captures abrupt changes of ground surface using small infrared, ultrasonic sensors. Leverages the information of Smartphone by lower down energy consumption, cost.

KEYWORDS: Mobile handsets, Hazards, Sensors, Distance measurement, Reliability, Estimation, Legged locomotion.

I. INTRODUCTION

Mobile devices evolve to be powerful and pervasive computing tools so; their usage continues to increase rapidly. Continuous usage of Smartphone causes an effect on pedestrian attention and walking. While using the mobile phone pedestrian neglect obstacle, unseen platform change, neglect upcoming vehicle may cause an accident. To avoid an accident and resolve effect by detecting visual and auditory task [13]. Smartphone are equipped various sensors to sense the mobile motion, touchstrokes, holding orientation etc. such sensors have been utilized in numerous contexts such as for detect user physical activity [14] and sensing around a mobile device [2], for the position based risk awareness [10], for interactive activity recognition [3]. There are various sensors in the mobile device like accelerometer, magnetometer, gyroscope, proximity, light sensor, camera etc. also compare the external sensors like infrared sensor [1], ultrasonic sensor [4, 16] for ranging data.

This paper systematically reviews various efforts made in the Pedestrian safety system to strengthen its efficacy and security. The review and its outcome are further organized as follows. Section II reveals various algorithms used in hazard detection for pedestrian safety. Section III reviews the literature in related work Section IV concludes the review.

II. REVIEW ALGORITHMS

To detect various hazard through Smartphone using various sensors and GPS techniques. It may use Walking speed estimation algorithm and iterative magnetic triangulation algorithm in most of the systems.

ITM algorithm interact with global coordinate n magnetic sensors (like a compass) to track a pedestrian walk direction, position through GPS. It used with Human walk Analysis (HWA), Local Direction Estimation (LDE), and Global Direction Estimation (GDE) methods.

Walking speed estimation algorithm used to estimate walk speed of pedestrian while using a mobile phone. Walking speed estimation algorithm may use with various techniques like INS, PDR, sampling window method.

The IMT and walking speed estimation algorithm as follow:

A. *Iterative Magnetic Triangulation (ITM) algorithm [5]*

Algorithm 1: Pseudocode for the IMT algorithm

Data: continuous magnetometer data
Result: θ_{est}
$< R_i,\ R_{i+1},\ R_{i+2} > =$ Vector Selection(filtered input);
$r_G =$ geomagnetic intensity;
while $r_G > threshold$ **do**
  for $\theta_G \leftarrow 0\circ$ **to** $360\circ$ **do**
    $G_\theta =$ vector with magnitude r_G and angle θ_G ;
    $I_i = R_i - G_\theta$;
    $I_{i+1} = R_{i+1} - G_\theta$;
    $I_{i+2} = R_{i+2} - G_\theta$;
    $< P_i,\ P_{i+1},\ P_{i+2} > =$ pairwise intersections of $< I_i,\ I_{i+1},\ I_{i+2} >$;
    $t_\theta =$ sum of all pairwise distances between P_i, P_{i+1} and P_{i+2}. ;
    Store $< (t_\theta, \theta_G) >$ in T ;
    if *Locus of* $< P_i, P_{i+1}, P_{i+2} >$ *goes irregular* **then**
      reduce r_G exponentially ;
      break ;
    end
  end
  $\theta_{est} = \theta_G$ for which t_θ is minimum in T ;
  return θ_{est} ;
end

B. *Walking Speed Estimation Algorithm[6,9]:*

Step1. An acceleration signal first partition with sliding window with 80% overlap in m samples and 100Hz sampling rate. Human walk having cyclic motion so calculate a magnitude of the low-frequency portion of the acceleration signal spectrum using District Fourier Transform (DFT).

Let $a_j = (x_j; y_j; z_j)$ $1 \leq j \leq m$ is one sample within the window with respect to orientation.

$m_j = || a_j ||$

where,

$x_j; y_j; z_j$ is Triaxial Accelerometer Parameters.

a_j , Original Acceleration Vector.

m_j, Acceleration Magnitude.

Step 2. Calculate unit gravity vector by taking the mean of acceleration vector over the entire window.

$$\hat{g} = \frac{(x;y;z)}{||x;y;z||}$$

where, $\hat{g}$ is unit gravity vector.

Step 3. Estimate vertical and horizontal acceleration.

Magnitude of vertical acceleration.

$v_j = a_j \cdot \hat{g}$

Projection of acceleration onto vertical component.

$v^{proj}_j = v_j \cdot \hat{g}$

Magnitude and Projection onto horizontal acceleration.

$h^{proj}_j = a_j - v^{proj}_j$

$h_j = ||h^{proj}_j||$

where,

v_j , Magnitude of vertical acceleration with respect to a_j .

h_j , Magnitude of horizontal acceleration with respect to a_j .

Step 4. The value of horizontal acceleration use over each window to calculate walking speed.

III. RELATED WORK

Mobile phone apps emerged that are devoted to increasing the safety of pedestrian mobile phone users. Among these apps, some utilize the camera module. For example, X. D Yang's

Surround-see [2] uses an Omni-directional camera to detect user activity and SpareEye [15] use the only camera to provide attention as a blind smartphone. CrashAlert [3] and WalkCompass [5] recognize the user's physical motion while walking to enhance peripheral alertness for eyes-busy mobile interaction. C. Huang's Ins and Pdr based tracking [7] and LookUp [18] use shoe mounted inertial sensor module. X. Liu's UltraSee [4] detect abrupt changes of ground surface using ultrasonic sensor. Type N Walk [11] and WalkingText [12] display a transparent background image captured by the rear camera, which allows users to see the environment ahead through the mobile phone. WalkSafe [8] could detect the approaching vehicles by processing the camera video frames. A system proposed in [10, 17] exploits the GPS sensor to identify whether a pedestrian is in-street rather than on the sidewalk and notifies the user when such an event occurs. Despite the promising results achieved, these apps have some limitations. None of them is able to detect some more common and equally dangerous situations such as falling down stairs/platforms. Though the apps [4] [11] and [12] may help tackle this problem, continuously turning on the camera module drains the battery quickly. Besides, the performance of the apps may be negatively affected by the low-light environment. More importantly, even if the dangers ahead are displayed as the background image, the user who is distracted by the mobile phone apps may not be aware of them.

IV. CONCLUSION

In this paper, various characteristic feature of the pedestrian safety system has been discussed and interpreted. Section 2. Discuss the interaction techniques and algorithm to detect hazard and section 3. Discuss the various hazard detection systems with operations to detect various hazards for pedestrian safety.

Author	Paper Title	Algorithm /Methods	Purpose
Xuefeng Liu, Jiaqi Wen, Jiannong Cao, and Shaojie Tang	InfraSee: An Unobtrusive Alertness System For Pedestrian Mobile Phone Users	Infrared sensor, GLRT, Walking speed estimation and C4.5 Classification algorithms are used.	Infrared sensor to detect distance accurately. Walking Speed Estimation algorithm to estimate walk speed and direction using global coordinates. C4.5 classification algorithm for form decision tree.
X.-D. Yang, K. Hasan, N. Bruce, and P. Irani	Surround-See: Enabling Peripheral Vision on Smartphones During Active Use	Surround-See, equipped with an Omni-directional camera. And use set vision algorithm.	An Omni-directional camera that enables peripheral vision around the device to augment daily mobile tasks. Set vision algorithm calculate the pixel of field-of-view provided by Omni-direction camera.
J. D. Hincapi´e-Ramos and P. Irani	CrashAlert: Enhancing Peripheral Alertness For Eyes-Busy Mobile Interaction While Walking.	CrashAlert: use Walking User Interface window (WUI)	WUI on mobile device provide distance and position for pedestrian to give alert.
Xuefeng Liu, Jiaqi Wen, Jiannong Cao	We Help You Watch Your Steps: Unobtrusive Alertness System For Pedestrian Mobile Phone Users.	UltraSee: Ultrasonic sensor, outlier removal algorithm, GLRT and danger detection algorithm are used.	Ultrasonic sensor use to measure distance between sensor and device. Outlier removal algorithm used to remove noise induced in walking speed. GLRT method replaces unknown parameters by their maximum likelihood estimates. Danger detection algorithm used to detect hazard on the basis of distraction level
N. Roy, H.Wang, and R. Roy Choudhury	I Am A Smartphone and I Can Tell My User's Walking Direction.	WalkCompass: exploits smartphone sensors to estimate the direction while walking. HWA, LDE, GDE methods	Human walk Analysis (HWA) do analysis of human walk pattern. Local Direction Estimation (LDE) collects values from accelerometer and classifies data.

		and IMT algorithm used.	Global Direction Estimation (GDE) Provide the global coordinate to IMT algorithm for walk direction estimation
J. Yang	Toward Physical Activity Diary: Motion Recognition Using Simple Acceleration Features With Mobile Phones	Motion recognize through Accelerometer sensor. Decision tree classification, k means clustering and HMM based viterbi algorithm used.	HMM based viterbi algorithm used to smoothing the classified data of decision tree classification
C. Huang, Z. Liao, and L. Zhao	Synergism of INS And PDR in Self-Contained Pedestrian Tracking With a Miniature Sensor Module.	MEMS Sensor-based pedestrian tracking technology. Strap-down Inertial Navigation system and Pedestrian Dead-Reckoning techniques used.	MEMS sensor mount on shoes and detect walk parameters (turn left/right, straight) using GPS parameters. Strap-down Inertial Navigation system and Pedestrian Dead-Reckoning techniques used to detect surface change while walking.
T. Wang, G. Cardone, A. Corradi, L. Torresani, and A. T. Campbell,	Walksafe: A Pedestrian Safety App For Mobile Phone Users Who Walk And Talk While Crossing Roads	WalkSafe: constantly listens to background noise to detect incoming vehicle to avoid accident. AdaBoost Machine Learning technique and Vehicle Detection algorithm used.	AdaBoost Machine Learning technique to work with offline coordinates. Vehicle Detection algorithm used to detect upcoming vehicle to avoid accident.
J.-g. Park, A. Patel, D. Curtis, S. Teller, and J. Ledlie	Pose Classification And Walking Speed Estimation Using Handheld Devices.	Estimate Walking speed using mobile device. Pedometer sensor. machine learning method. SVM and C4.5 Classification.	Pedometer sensor to detect orientation. Machine learning method used for walking speed estimation. SVM and C4.5 Classification used for online pose classification.
S. Jain, C. Borgiattino, Y. Ren, M. Gruteser, and Y. Chen	On The Limits Of Positioning-Based Pedestrian Risk Awareness.	Inertial and positioning sensing technique	Inertial and positioning sensing technique used for pedestrian in-street detection.

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