A GPS-Based Wander Management System for the Elderly

Wen-Yu Chiu, Kuang-Nan Huang, Ying-Chieh Huang, Chi-Kai Huang, and Hsin-Te Wu

***Abstract*-- The proportion of elderly population in Taiwan has been on the rise, as ageing society becomes a major issue. According to Taiwan's Ministry of the Interior, in 2016, the average life expectancy was 76.8 years for males and 83.4 years for females, showing a gradual annual rise, which when coupled with decrease in birth rate led to continuous increase in ageing. Prolonged life has resulted in escalated incident rate; usually, in an ageing society, the two main physiological problems that the elderly face are dementia and need for other people's concern.**

This study employs webpage-obtained GPS (Global Positioning System) records as the main analysis method by utilizing GPS records to analyze and examine elderly behavior so as to understand the elderly's movement positioning. We can also use the GPS records to examine data and determine a movement range; further analysis allows us to categorize movements as either usual or unusual activities in order to explore user behavior. Our system analyzes early behavior to further understand the elderly's message behavior and motivation and then issue warning or response.

I. INTRODUCTION

The arrival of an ageing society has brought us many issues of concern – for instance, an elderly might leave home but forget their destination or suddenly fall ill on the road and engage in danger, so family members are often bound to track the elderly's movements closely or even accompany them at all times as they constantly engage in exercising or socializing outside their homes. We all know that adequate exercise benefits the mind and body; however, as the elderly age, their memory gradually fails and they often forget the way home. Employing GPS systems to monitor the elderly's movement paths helps keep them safe.

Reference [1] uses the hidden Markov model and RSSI to connect to nearby cellular base stations for conducting predictions and providing a driver's anticipated path on each road section. Reference [2] conducts GPS accuracy tests using robot drivers while this study utilizes visual diagnosis to detect routes and road signs in order to improve the overall GPS accuracy. Reference [3] combines wireless sensor network technology with GPS technology to predict a node's movement positions. Reference [4] proposes using Android smartphones to determine indoor/outdoor locations to perform positioning detection using different algorithms. Meanwhile, Reference [5] employs pedestrian dead reckoning and Kalman filtering to perform tracking and positioning on smartphones.

This study proposes calculating slopes to determine whether an elderly's movement path has strayed from their usual directions. Given that the elderly mostly follow fixed routes in their walking or mobility scooter driving, records of such routes can serve as determination of usual routes so that if and whenever they stray from said routes, the system can issue a warning. This study uses slope calculation to determine whether the route has been astray, and conducted experiments to verify the feasibility of such algorithm.

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II. THE PROPOSED SCHEME

As shown in Figure 1, triangulation is performed by combining Arduino with GPS modules. When an elderly steps out, their selection of an often-travelled route is recorded and sent to the database, so that when they choose the same route again later on, the system detects whether it is the same route. If the elderly wanders astray or never achieves the destination, the system automatically issues a warning to family members; this method relieves caretakers from the burden of constant surveillance of the elderly's movements by only notifying them when the elderly have gone missing.

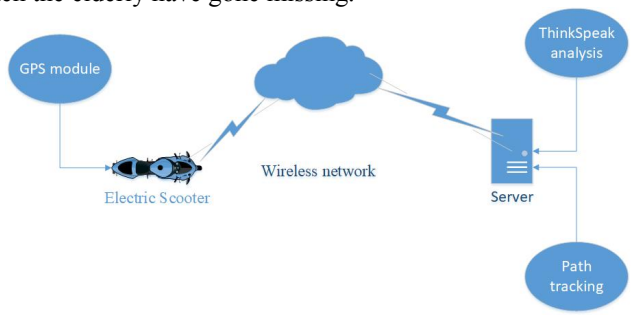

Figure 1: Illustration of the System's Process The database

The database distinguishes usual routes from real-time routes. A usual route consists of points on usual paths. Any two points on a usual route can form a rectangle, and the two points can be viewed as consisting a slope. A real-time position point consists of the elderly's position data as received by the server; any two points yield the following four elements, as shown in Figure 2: lonmax, lonmin, latmax, and latmin.

Each rectangle consists of two usual-route points, that is to say, a real-time route's longitude will fall between lonmax and lonmin while the latitude falls between latmax and latmin.

III. EXPERIMENT RESULTS

This study experimented implementing the GPS-based wander management system. We developed the webpage using PHP and, for the hardware, employed Arduino as the main development board. Table 1 shows the software and hardware used in developing our system. Figure 3 simulates a usual

route taken by an elderly while Figures 4 and 5 illustrate results of safety and warning. Our proposed scheme underwent testing upon application development; results indicate that functions can operate normally and that optimization can allow our system to be more comprehensive.

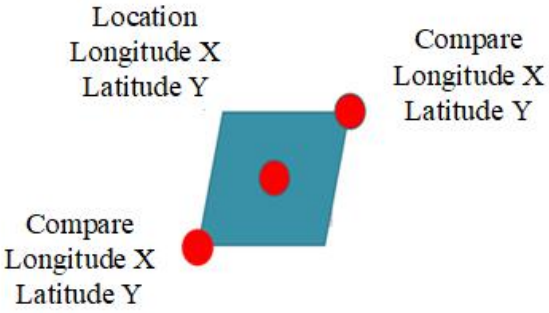

Figure 2: Illustration of Data

Table 1: The System's Software and Hardware

Hardware Elements
Arduino GPS Modules Esp8266 Module Buzzer
Software Elements
Arduino Development Environment (C programming language) PHP+xampp

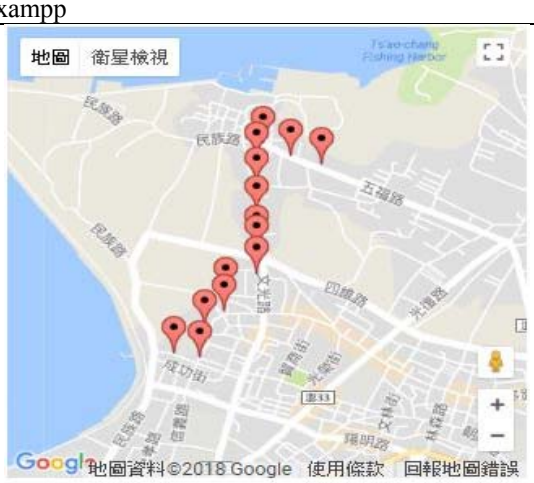

Figure 3: A Usual Route

Figure 4: A Successful Route

Figure 5: A Failed Route

IV. Conclusion

This study has realized a positioning system for the elderly. Experiment results show that we are able to determine when an elderly wanders astray from their usual movement paths. Our proposed system can be applied towards mobility scooters and elderly positioning and tracking. Currently, the system is ready to be implemented on relevant applications, and is beneficial towards future research in issues such as elderly behavior analysis.

Acknowledgment

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