Medication Reminding Activity Analyzer for Guided Independent Living Environments (MRAAGILE)

Implementing Motion Dependent Medication Reminders

Alexander Batrakov[1], Patrick Merida[1], Nathan Bartels[1], Eugene Chabot[1], PhD,
Patricia Burbank[2], DNSc, RN, Ying Sun[1], PhD
[1]Department of Electrical, Computer and Biomedical Engineering, and [2]College of Nursing, University of Rhode Island
Kingston, RI 02881, USA;

***Abstract*—The MRAAGILE is a device designed to monitor and reinforce medication consumption as well as promote a healthy daily regimen for those who choose to live independently. The device provides interactive reminder messages to inspire the user to follow directives. The purpose of this is to implement motion detection following a reminder to determine whether the user is responding. The device will receive instructions from the user manually on the device or by using a bluetooth wireless link to transmit the times for which medication is to be taken. After reminders are set, the mobile device will continue to function until the first reminder time is reached. A message will be played. If motion is detected, it will serve as an indicator that the message was acknowledged. If not, it will trigger an alarm to remind the user to complete the action. The alarm will deactivate once motion is detected. This device will be useful for increasing the independence for older adults who live in the community as well as assistive living environments.**

***Keywords*—medication reminder; embedded design; activity monitor; voice record/playback; independent living**

I. Introduction

Medication reminders play an important role in promoting independent living. The likelihood of an individual over the age of 60 adhering to medication distribution times is 26-59% [1]. While many people can rely on their short term memory to keep track of the times to receive medication, others do not have that luxury.

The implementation of these reminders typically includes reminders on a PC or TV, or some medium they spend large amount of time in front of [2]. Mobile phones are also good targets since they are easy to carry at all times.

Medication reminders on the market today all share a common flaw: the device does not benefit the user if the reminders are not noticed or prematurely acknowledged and subsequently forgotten. This is especially prevalent in those with impaired cognitive abilities which have problems with short term memory.

The purpose of our modifications is to couple monitoring of the time to a motion detector. This will mean that once the time for medication has been reached and the reminder will trigger, an alarm will be trigger if the user fails to take motion. This is especially geared toward the situation of an individual who leads a sedentary lifestyle, which is becoming increasingly common, and who frequently puts off moving and eventually forgets why they were supposed to move in the first place. The alarm will deactivate once motion has been detected and the device will await the next reminder.

II. Methods

A. Hardware

This wearable device has been developed with an embedded processor (PIC18F4525, Microchip, Chandler, AZ). A 3-dimensional accelerometer (STMicroelectroinics LIS302SG) is used to detect motions and to assess the intensity of activities. Currently, any motion in any axis will deactivate the alarm. A voice record/playback integrated circuit chip (Nuvoton ISD 1750PY) is used to store messages, record new messages, and playback the reminder messages. The mobile device uses a 9 Volt battery as a power source. Presently, the device allows for 6 messages for different reminders and a default alarm. A microprocessor monitors the time for reminder activation, controls the voice chip, and provides action log recording and extraction. The user interface includes two push buttons and an LCD character display to show current time and to confirm the unit is active during the *monitor* mode. During the *program* mode, the user (usually a care-giver or a relative) is able to set the alarm times and enter the voice instructions via the user interface.

B. Device Design

The Activity Analyzer with voice-Guidance for Independent Living Environments (AAGILE) is an ongoing project at the University of Rhode Island [3], [4]. One difference from the previous prototype [5] is adding the medication reminders (MR) instead of only having messages being played after extended periods of inactivity. Also, having the alarms be deactivated by using the accelerometer is also a new feature. Thus, the present project is named MRAAGILE.

Using two buttons on the device to scroll and select, the user will input the time for the Alarm (repeated as many times as needed to cover all medication taken). This data is stored in the PIC processor. The time will be monitored on the mobile unit and will trigger an alarm once the first alarm time has been reached and play until motion is detected. It will then reverence the voice chip and play the message or alarm chosen. Once motion is detected, the alarm will turn off and await the next scheduled alarm.

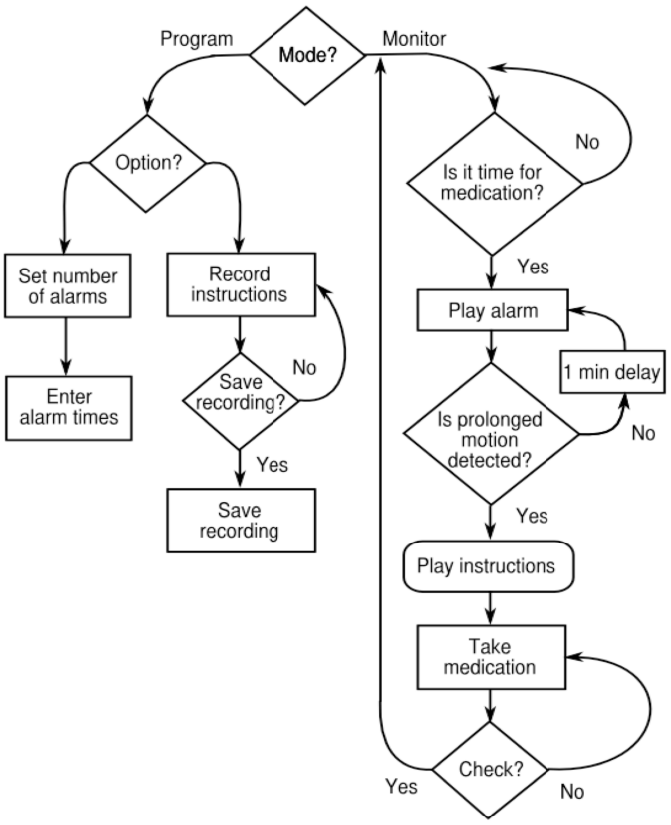

Fig. 1. Flowchart of the medication reminder with pre-recorded voice instructions.

As shown by the flowchart in Fig. 1, if the unit is being programmed, it will allow the user to set alarms and the type of medication that is to be taken for that allotted time. Otherwise, the program will monitor the time to see if an alarm time has been reached, then initiate an alarm. After motion is detected, it will deactivate that alarm and wait for the following alarm time.

III. Results

The device was initially implemented on a breadboard using a 9V rechargeable battery. After successful debugging and optimization, an engineering prototype was built with point-to-point soldering and encased in an ABS plastic box as shown in Fig. 2. The device was placed in a fanny pack and worn around the waist. The preliminary test has shown that MRAAGILE is capable of playing back pre-recorded voice messages at the pre-programmed times according the specifications.

IV. Discussion

The project has resulted an embedded device that provides reminders and voice instructions for daily medications. While many medication reminders are commercially available nowadays, ranging from labeled plastic containers to electronic message reminders, MRAAGILE has the advantages of its activity sensor and voice recording/playback capability. The

Fig. 2. Engineering prototype of MRAAGILE.

effectiveness should be increased by using the activity sensor as a feedback on whether the instructions are followed. In addition, a previous study [6] has shown that voice messages from known persons, especially the loved ones, are most effective to encourage the old adults.

Limitations of the present prototype include the following: First, the mobile unit's button can be inadvertently pressed. Second, the sound of the mobile unit may be too quiet to hear if the messages are played in a very noisy environment.

In addition to the older adult population, this Application should be useful for outpatients who are on medication, and can be programmed by a nurse or family member if the patient is unable to do so himself. Potential future uses of the device would be implementing it solely as an application for the android device and utilizing the accelerometer and processor, and with an internet connection, adding links to more information about medication being inputted and checking whether the amount being administered is in a dangerous range.

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