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A Smart Device Integrated with an Android for Alerting a Person's Health Condition: Internet of Things

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Abstract

Objective: The main objective is to develop a smart device, which is integrated in order to help the aged people during the time of medical emergency situations using Internet of Things (IoT). **Methods:** The technical methodology implemented is to develop a smart device which works on the basic support of the android application. The device serving people in danger is built using the smart phone applications, Bluetooth transmitter and receiver and microcontroller (Kiel micro vision). Kiel micro vision is an integrated development environment used to create software to be run on embedded system (like a microcontroller). Effective Quality of Service (QoS) is achieved using the concept of IoT. **Findings:** The concept of IoT is implemented in order to develop an environment which provides a unique way to communicate and transfer data from one end to the other end. The Internet of Things is a new way implementation in the field of medical background, which acts as a media for information retrieval from physical world to digital world, which is enhanced by the support of android platform. Hence the embedded system together constitutes two devices: Stationary device and a Movable device. The Stationary device is inbuilt with an ATMEL Microcontroller, RF Receiver, Bluetooth module, Step-down transformer, an LCD display, Voltage regulator, resistors and Capacitors. The movable device is inbuilt with two buttons along with a RF Transmitter. **Application:** The smart device for alerting a person's critical health condition is of good use as it is less expensive and easy to handle, since the people in need are helped in the right time. Moreover this system can also alert our neighborhood even in situations like robbery. The Stationary device which the person is handling can be made as a device attached to human body, say a watch. The size of the device is made smaller, even though the cost becomes higher. Call features also added instead of message feature because everyone looks on text message.

Keywords: Android, Bluetooth, Internet of Things, Kiel Micro Vision, RF Transmitter and Receiver, Smart Device

1. Introduction

The emergency alarming device is designed to benefit people on a medical background for those people who lose their lives because of the lack of facility to communicate their health conditions at the critical hours. The proposed idea would be advantageous when it comes to inform the dear ones of a person by alarming the health conditions. The system is cost effective, thereby making it affordable for people to try the device and get benefited. The application is developed for the purpose of alerting the neighborhood and the person's relatives or friends. Usually there are people who don't know to use smart phones. For that case, we have introduced two buttons which can be used to alert their relatives. On pressing any one of the buttons, the application developed and installed in smart phone performs the corresponding action. We have provided a simple and an effective user interface so

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that it becomes easy for the people to perform any of the actions. There are cases in which the mobile phones may be in silent mode. During those situations our information may not reach the person. So, we have developed another application which produces the alarm sound whenever the emergency message reaches the recipients, provided the recipient has that application installed in their smart phone. Thus we can help the person in danger using the advancement in technology.

The emergency alarming device for protecting the people in danger is developed based on IoT[1]. The device serving people in danger is built using the smart phone applications, Bluetooth transmitter and receiver and microcontroller. Hence, providing and efficient and a simple means of communicating the needs.

Antonio J. Jara[2] describes that both the communication and information access defines the basis to reach a personalized health end to end framework. Personalized health capability is limited to the available data from the patient. For that reason, this work presented an interconnection framework for mobile health based on IoT. It also allows patients to monitor and supervise by remote centers and personal platforms such as tablets. The proposed interconnection framework and the proposed protocol for the sensors have been exhaustively evaluated in the framework of the AIRE project, which is focused on patients with breathing problem.

Pedro Castillejo[3] insisted that the application based on the Wireless Sensor Networks for Internet of Things (IoT) scenarios are on the raise. They offer multiple possibilities towards fields, like e-health or human physiological monitoring. An application has been developed for its usage in scenarios where data collection is applied to smart spaces, aiming at its usage in fire fighting and sports. This application has been tested in a gymnasium with real, non-simulated nodes and devices. A Graphic User Interface has been implemented to suggest a series of exercises to improve a sportsman/woman s condition, depending on the context and their profile. This system can be adapted to a wide variety of e-health applications with minimum changes and the user will have to interact using different devices, like smart phones, smart watches and/or tablets.

Yuan Jie[4] Fan describes that the Internet of Things (IoT) makes all objects become interconnected and smart, which has been recognized as the next technological revolution. As its typical case, IoT-based smart rehabilitation systems are becoming a better way to mitigate problems associated with aging populations and shortage of health professionals. This paper presents an ontology-based Automating Design Methodology (ADM) for smart rehabilitation systems in IoT. Ontology aids computers in further understanding the symptoms and medical resources, which helps to create a rehabilitation strategy and reconfigure medical resources according to patients' specific requirements quickly and automatically.

Ming Yan[5] focused mainly on the Smart Living, more specifically the home lighting control system using Bluetooth technology. The system has been successfully designed and prototyped to monitor and control the lighting status using an Android Bluetooth-enabled phone and Bluetooth modules. The microchip is used to assist gathering status of the lighting and provides interface to control the lighting. The Bluetooth module sends and receives the Commands from the Bluetooth-enabled phone. Android system JDK is used to develop the system, which is proved to be very efficient and convenient. It is concluded that smart living will gradually turn into a reality that consumers can control their home remotely and wirelessly.

Chung[6] described that for smart living, interactive applications are increasingly important especially on interaction of people and the environment. In this work, a Bluetooth-based mobile sensor interactive application in Android[7] was designed and implemented. An application framework of interactive applications is presented. The results show that animation view on the application changes along with the mobile sensor value. The power issue was also measured and concluded as extending handler timing to reduce the consumption.

2. Our New Approach

We propose to systematically develop an emergency alarming system, which is used to depict the situation of the person in danger. The proposed system contains a transmitter attached to the device, which is to be held by a patient. In case of any emergency, the person is taught to press the button provided in the device. On pressing any of the two buttons, the transmitter transmits a signal to a microcontroller (which controls all the signals sent from the transmitter and is also responsible for transmitting the signal to the Bluetooth transmitter). The signal is further sent to a smart phone's through the Bluetooth receiver. Hence with the help of these requirements the alarm sound or the alert message is sent to the caretakers

indicating the status of the patient. Therefore, this system provides an effective background support to the people in need of medical treatments.

3. Framework Model of the Emergency Alert Machine

The overall layout illustrating the work flow of the emergency alarming device is represented in the form of a framework diagram shown in the Figure 1. Initially, the device is classified as two important namely, the movable device and the stationary device and a smart phone application. The movable device is the device that is provided to the patient and the device is embedded with RF transmitter, buttons (buzzer), Microcontroller and a Bluetooth transmitter. Basically, the patient is being taught about the device containing two buttons.

When the patient presses any one of the two buttons available on the device indicates that the patient is in need of help. The information of the patient's status is estimated by the caretakers by receiving an alarm sound or an alert message, at times both alarm and message indicating the higher level of the emergency.

Therefore, when the patient suffers from any kind of danger intimates the caretakers by pressing the buzzers, due to which the signals are being generated with the help of RF transmitter and these signals are controlled by the Microcontroller chip that is being embedded in the device. These signals are transmitted by the Bluetooth transmitter to the stationary device that is held by the caretakers.

The Bluetooth receiver, attached to the stationary device receives the signals and hence these signals trigger the application that is being created and installed in the smart phone that is held by the caretakers. Hence it is mandatory that the Bluetooth connectivity on both the sides of the patient and the caretakers are kept "ON". With the help of these signals and the Bluetooth connectivity the caretakers are intimated with an alarm sound or an alert message. The signals received by the Bluetooth receiver triggers the mobile application installed in the caretakers mobile.

As a result, two actions are set to take place depending on the button pressed by the patient. An application is being developed in such a way that it carry outs two kinds of action such as, on pressing the button1, an alarm sound is generated to the neighbors and the relatives.

Whereas, on pressing the button 2 an alarm sound along with an alert message is being sent to the caretakers. Even if the mobile is left in a silent mode, the automatic alarm sound and the message tone will be generated, indicating the emergency level.

In case when the button 2 is pressed, where both the alarm and message is sent to the recipient in such cases another application is being triggered known as Receive SMS, which is responsible for providing message and generating the sound even in silent mode. Hence the result of these actions performed by the applications developed the patient's critical health condition may be treated as much as possible.

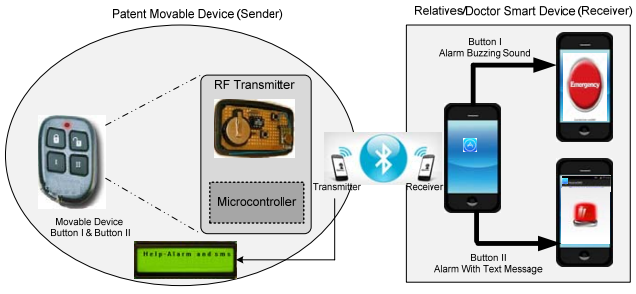


Figure 1. An overview of patent's movable device integrated with android mobile.

4. Movable Device

The movable device is the device which is found attached to the patient's body or being held by the patient in order to alert the caretakers in case of any emergency. The movable device consists of an RF transmitter embedded with the device and also consists of two different buttons performing two different actions. The below shown Figure 2 resembles the buttons being placed on the movable device.

When button 1 is pressed the alerting alarm sound is generated to the neighbors. Whereas, when button 2 is pressed and alarm sound with an alert message is being sent to the relatives and the caretakers, even if the mobile is left in a silent mode. The movable device contains an

Figure 2. The emergency buttons.

RF Transmitter attached to it, which is responsible for transmitting the data up to certain distance.

The 433 MHz RF Transmitter module shown in the below Figure 3 is a compact and easy-to-use and suitable for transmitting data up to 45m (150 ft.). Using this it is easy to connect to any microcontroller with just 1 wire and can communicate at speeds up to 2400 baud. Radio Frequency (RF) Modules allow you to exchange data between suitably-equipped microcontrollers without wires. The 433 MHz RF Receiver Module is a compact for receiving data from up to 150 ft away. The transmitter module is only 1/3 the size of a standard postage stamp and can easily be placed inside a small plastic enclosure.

An encoder is also embedded in the movable device; the encoder device is used to change a signal (such as a bit stream) or data into a code. The encoder may serve any of a number of purposes such as compressing information for transmission or storage, encrypting or adding redundancies to the input code or translating from one code to another. The block diagram representing the encoder and the RF transmitter on the transmitter section is shown in the Figure 4.

The term SW1 and SW2 in Figure 4 represents the switch 1 and 2, which is connected to the encoder. The encoder receives the information and converts the data or signals into the code and is given to the RF transmitter, where the transmitter is responsible for transmitting the code to the receiver.

The signal therefore attained as a result of pressing the buttons is transmitted from the RF Transmitter to a microcontroller. The microcontroller used here is ATMEL AT89 S52, which is capable of providing high performance. The microcontroller is manufactured as an 8-bit Microcomputer with 4K bytes of Flash Programmable and Erasable Read Only Memory (PEROM). The microcontroller is used to control and to store the signals to be transmitted. From the microcontroller, the signal is being transmitted by a Bluetooth transmitter to the smart phone.

Pin 1 : Ground (0v)
Pin 2: Serial Data Input
Pin 3: Vcc – Supply Voltage (5v)
Pin 4: ANT – Antenna output

Figure 3. RF transmitter PIN diagram.

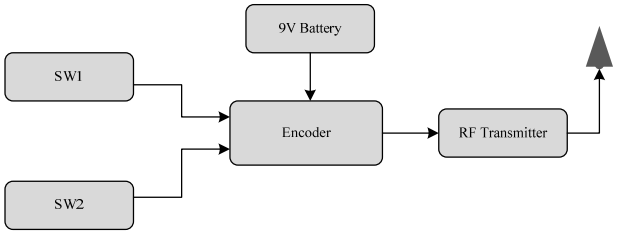


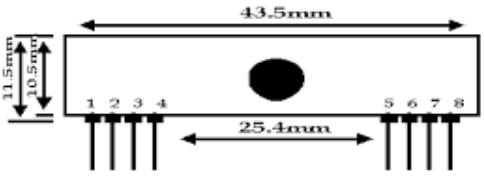
Figure 4. Block diagram of transmitter section.

5. Stationary Device

The signal thus attained from the Bluetooth transmitter is being received by the Bluetooth receiver on the other hand. The received signal is being transmitted to the RF receiver and the Decoder in order to trigger the application generated in the smart phone.

The RF receiver RWS-434 is shown in the Figure 5 and also operates at 433.92MHz and has a sensitivity of 3uV. The RWS-434 receiver operates from 4.5 to 5.5 volts-DC. The maximum distance over which you can communicate (reliably) will vary based on a number of factors. The best range will be had in what is called "line-of-sight". This is when the Transmitter (TX) and Receiver (Rx) can see each other (i.e. no obstacles blocking the path). In line-of-sight conditions, you can expect ranges of around 45m (150 ft.). Transmitting though walls of buildings will reduce the range. The signal thus received is now given to the decoder for decoding the encoded signal.

A decoder is a device which does the reverse of an encoder, undoing the encoding so that the original information can be retrieved. The same method used to encode is usually just reversed in order to decode. In digital electronics this would mean that a decoder is a multiple-input, multiple-output logic circuit (n-2n). The



pin 1 : Gnd
pin 2 : DigitaL Output
pin 3 : Linear Output
pin 4 : Vcc
pin 5 : Vcc
pin 6 : Gnd
pin 7 : Gnd
pin 8 :Ant (About 30 - 35 cm)

Figure 5. RF receiver PIN diagram.

block diagram illustrating the receiver section is shown in the below Figure 6.

Thus this received signals being retrieved is used to trigger the mobile application installed in the caretakers mobile. As a result, two set of actions are set to take place here depending on the button pressed by the patient. An application is developed for carrying out the following two actions. On pressing button 1, alarm sound occurs which is used to alert our neighborhood. On pressing button 2, alarm sound at both ends along with an alert message is sent to our relatives or friends. The alert message and alarm is sent to the recipient even when the mobile is in silent mode when the button 2 is pressed for that case another application known as "Receive SMS" is triggered which produces alarm sound even when the smart phone is in silent mode. Thus, as a result of these two actions, the patient's critical health condition may be treated upon at the earliest.

6. Smart Alert Application

As a result of signal being received by a Bluetooth receiver attached to the smart phone, an app is triggered in the smart phone device so that button 1 and button 2 actions are activated. There are two applications being developed here, for the purpose of two actions. Application 1 is named as "Sample application" and application 2 is named as "Receive SMS application". These two apps work simultaneously. Their main aim is to provide the end user with human resource at any emergency situations.

The user interface is also provided in such a way that any individual would find it easy to understand the process

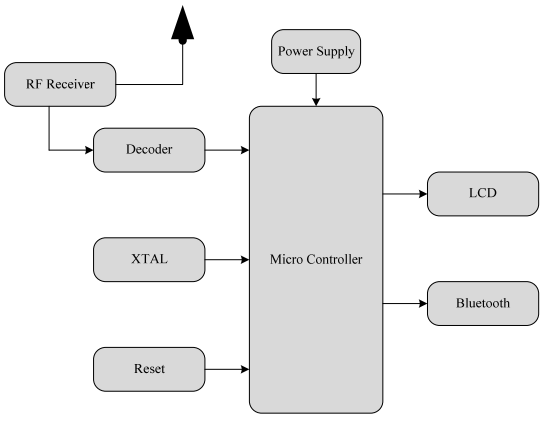


Figure 6. Block diagram of receiver section.

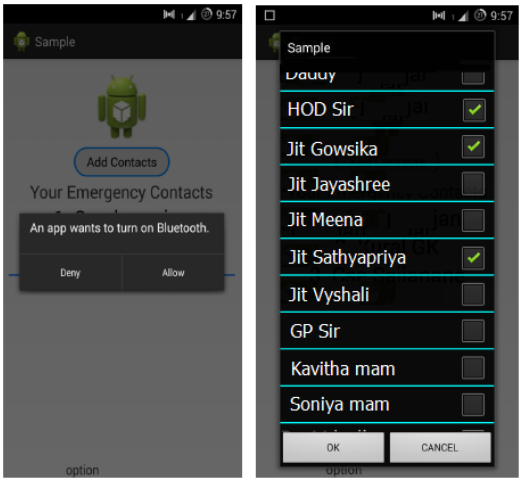


Figure 7. Bluetooth connectivity and contact list.

running in front of them. When button 1 is pressed, an alarm is activated. When button 2 is pressed, an alert message is sent to the relatives and the neighbors along with the alarm sound. When button 1 is pressed, the application 1 named as "sample application" is being activated, which generates an alarm to the care takers.

As soon the button 2 is pressed, another application is being triggered in the smart phone. The second application is being developed in order to indicate the receipt that they have got an alert message with an alert tone. Thus this application is used to activate the alarm one even when the mobile is in silent mode. The Bluetooth connectivity and the contact list in the application is illustrated in the following Figure 7.

7. Conclusion

Thus we conclude that this smart device for alerting a person's critical health condition is of good use as it is less expensive and easy to handle. We would be able to help the people in need at the simplest way. Moreover this system can also alert our neighborhood even in situations like robbery. The usage of another application to alert the recipients is done in order to bring into their notice that they have received an important message. The future enhancement is achieved by designing a device which the person is handling attached to human body, say a watch. Since that leads to reduction in the size of the device and ultimately the cost becomes heavier. Call feature can also be substituted instead of message feature because, not all will take a look at their text messages every time.

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