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Remote Control of Baby Room in Embedded System Technology

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Abstract: In this study, a remote controlled smart crib design and application was performed that alerts by sending voice message or SMS via prepared Android software to mobile phones of relevant people when baby cries or gets wet. Bluetooth HC-05 module, BDT21 temperature and humidity sensor, FC-28 wetness sensor, sound decibel sensor, relay, DC motor, SD cart module, speaker IP camera, Arduino Uno R3 and Android software system were used for this purpose. When baby room is desired to be monitored, a password is asked by the system for security purposes. Mother and Father can watch baby room as online from IP camera and can shake crib with remote control if necessary. During shaking crib, the system helps baby to sleep by playing previously specified lullaby. Baby room was provided to stay at appropriate temperature. Mobile phone keeps all events that occur when the system is open and sends this report as an e-mail to defined e-mail address when requested. The system will be helpful for especially working mothers and fathers since they come tired from work, staying sleepless in the night, and it reduces efficiency in the workplace they work. With the system that we designed and implemented; this will be prevented in a certain extent.

Keywords: Android, Arduino, Sensors, Crib, Mobile application, Remote Control

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1. Introduction

The biggest problem of working parents today is that babies wake up at night and parents stay sleepless. This problem affects parents and mothers especially in light sleeper babies and makes their lives difficult.

Sensors used by Ebenezer [1] included a temperature sensor to show baby's temperature and a breathing sensor that sends a signal in case of apnea. A GSM modem working over RS232 was used to send messages to parents if baby crying is not interrupted for a certain period. Harper [2] stated that this provides same effect that can occur when a mother shakes baby in crib in his study. He indicated that shaking of crib stops when a slight resistance is encountered. He met the energy of the system with solar panel used [3]. The study constitutes the first leg of the wider study of "remote control of multiple model vehicles at the same time" [4]. At the same time, owner of car is called by mobile phone during these events. Thus, the possibility of stolen the car by starting is

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made impossible [5]. There are more than 1 million applications in Google Play Store, where developed applications are presented to end user. These applications are written in Java language [6].

Today, Arduinos are frequently used because they are easy to set up, can work multiple, read information from input devices such as sensors, antennas and potentiometers, and send information to output devices such as DC motors, LEDs, LCD screens [7]. This platform consists of auxiliary tools such as debuggers, software libraries and emulators [8].

Android offers some techniques and methods to make memory more efficient [9]. On the other hand, security, memory and process control, filing and connection I / O processes and device drivers are the structures that Linux kernel provides direct resources [10]. It is an open source; Linux based mobile operating system developed for mobile devices. The extension of the developed applications is ".apk" [11].

Some of the studies related to the subject in the literature are as follows. Oztekin and Bolukbasi [12] carried out the control of a 3-axis plotter machine with microcomputer architecture BZK.SAU.FPGA. In addition, wireless remote control car can be designed in his study of a group of universities in South Africa in Pretoria, it has been developed using the internet environment [13]. A group at the University of Tubingen, which can be remotely controlled using IPad, designed a low cost unmanned aerial vehicle (quadrocopter). [14]. Dalkılıç and Özcanhan (2016) developed a mobile vehicle using arduino uno. This tool can be remotely controlled via bluetooth via a smartphone application with Android operating system [4]. Lubbe and Kluge [13] have developed a prototype car that can be controlled remotely over the wireless network. By integrating the camera on the car they developed, they realized the image transfer from here. Sinha et al. (2016) have developed a vehicle safety system that can be installed in any vehicle. The system is activated by pressing a button and when the vehicle is stolen, an alarm is sent via the GSM module and the location of the vehicle is reported via GPS [15].

As this study allows babies to sleep again without waking up, especially working mothers and fathers were prevented from staying sleepless and helped them work more efficiently in their workplaces.

2. Materials Used in Remote Control Application of Baby Room

2.1. Bluetooth HC-05

The HC-05 module is a Bluetooth SPP (Serial Port Protocol) module that can be easily controlled via pins on it. Module supports Bluetooth 2.0 technology. In this way, it enables communication at a frequency of 2.4 GHz. Communication can be made in an area of approximately 10 meters thanks to module. The sensor operates at 3.3 V.

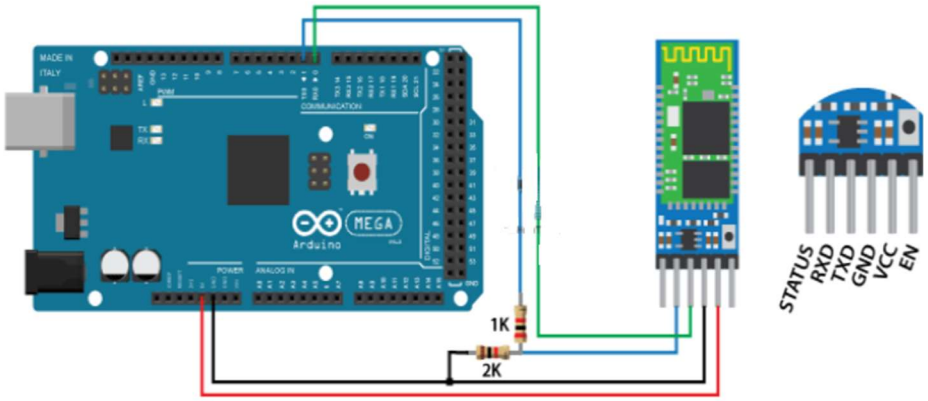

Figure 1. Serial Communication of the Bluetooth HC-05 Module with Arduino

2.2. DC Motor

There is a 24 V and 3000 RPM DC motor inside metal motor box, which is resistant to heating and used for easy assembly. However, it was supplied with 12 V to prevent excessive motor force and possible safety weakness. As seen in Figure 2, motor is connected to crib with cable attached to end and shakes crib with command from Arduino.

Figure 2. Installing DC Motor in Crib

2.3. IP Camera

IP camera was used to monitor baby room or baby from home through mobile phone by day/night. IP camera used is 720p (HD) CMOS sensor IP camera with Vstarcam C7824WIP model number. Baby or the room can be viewed remotely thanks to this camera.

Figure 3. IP Camera.

3. The developed Software

After the program is installed on mobile phone, it will open with the screen in Figure 4. Temperature and humidity values of room taken from Arduino are shown in order. With sensor in Arduino, phone receives a warning when baby is wet. By providing IP Camera connection, baby room can be watched live, so that mother and father can control baby instantly. If baby's crib is desired to be shaken manually, first “Lullaby” option is checked. If checked, Arduino plays lullaby previously loaded on SD card while shaking crib. If unchecked, baby's crib is shaken at the time intervals selected as "1 min", "5 min" or "10 min". Mobile phone connection is made with Arduino. Phone's BT connection must be active before connection can be made here. Events that will occur on report screen are reported.

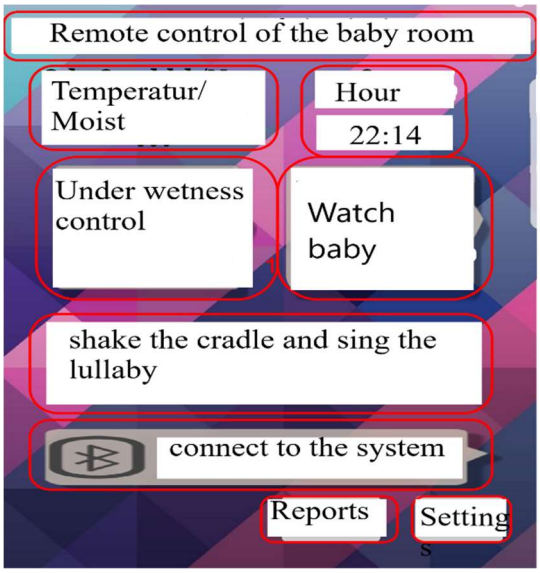

Figure 4. Program Main Screen

After Arduino connections are made, program is loaded on mobile phone and program settings are made, the system starts to operate.

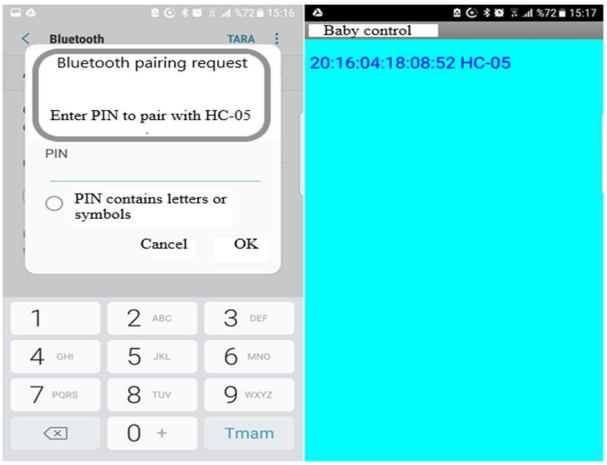

Figure 5. Mobile Phone BT Describing Screen

For the running of the system, first of all, BT sensor on Arduino and sensor named HC-05 on Arduino are introduced in settings section of mobile phone. After user provides connection between mobile phone and sensor, Arduino and mobile phone are connected to each other by entering program.

Figure 6. Setting Screen

After connection is established, desired values must be entered by entering “Settings” screen. Especially IP camera IP and port defined earlier has to be entered here. In Figure 6, first entry to settings screen is seen on the left and state after entering settings is seen on the right.

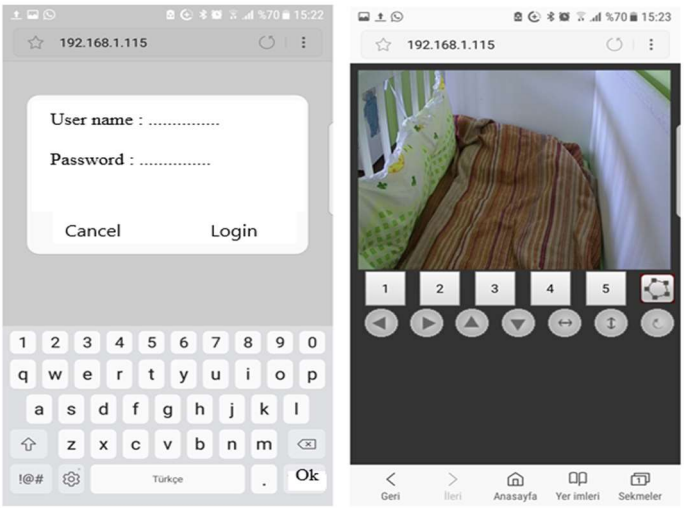

Figure 7. IP Camera Screen

In addition, when desired to watch baby, password is asked at first time in terms of security. In this study, username is defined as "admin" and password is “888888”. Once this one-time password is entered, phone will remember it and will not ask for it again. Figure 7 shows password screen on the left and camera screen of baby room after entering password on the right.

Decibel sensor on Arduino detects ambient sound and if this value is greater than defined decibel range, crib shakes for 1 min. In the meantime, lullaby is also played. If baby continues to cry after shaking, it shakes for 1 more minute, this repetition continues 4 times. If baby is still crying at the end of 4th shake, mobile phone application notifies defined warnings or sends a text message to

mobile phone. Also, if baby cannot be silenced after 4 shakes, it is saved on "Reports" screen on phone. "Wetness sensor" on Arduino is placed in crib between bed and bed sheet. In this way, the sensor will detect humidity if there is an overflow from diaper, and information will be sent to mobile phone if humidity is above defined value.

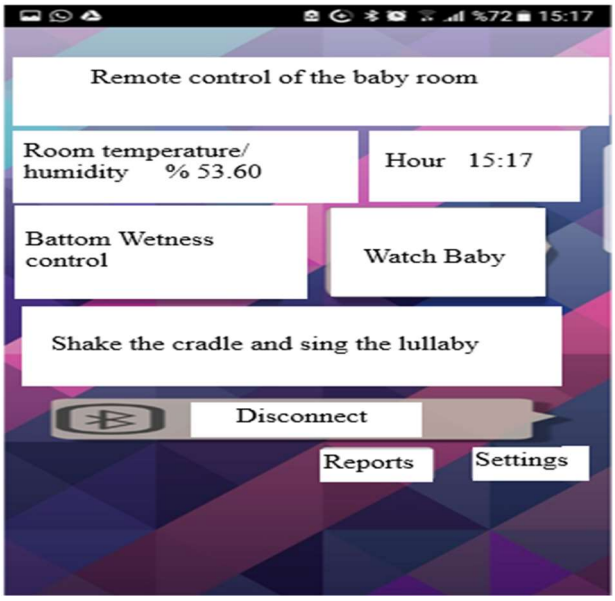

Figure 8. Temperature / Humidity Indicator and Warning Message.

“Temperature / Humidity” section on mobile phone application screen displays room temperature and humidity information on the screen by processing instant data from Arduino. If room temperature is below or above the ideal sleep value (20 – 24^{0}C), information will be given to mobile phone and incoming information will be displayed as a warning immediately, if defined, information will be sent to mobile phone and recorded on “Reports” screen.

In addition, heater or cooler that will be controlled by Arduino and will be connected according to seasonal conditions will be activated and will bring room temperature within ideal temperature values. In Figure 8, “Temperature / Humidity” section on main screen and message received when temperature exceeds ideal value can be seen. If option “Send as Mail” is selected from “Reports” screen before exiting the program for archiving reports, it will be sent to e-mail address defined earlier.

4. Results and Suggestions

With this system designed and applied, babies re-sleeping in a very short time after waking up, which is a big problem for mothers and fathers, was automatically provided. When sound sensor placed in crib detects crying of baby, crib automatically shakes for one minute as electronic card

triggers engine, if baby continues to cry, one minute shaking is repeated four times, and if baby continues to cry, a warning signal is sent to defined mobile phone. The program on phone processes warning and warns relevant people as an information message, voice message or SMS. During shaking od crib, the system helps baby to sleep by playing previously specified lullaby. Mobile phone keeps all events that occur when the system is open and sends this report as an e-mail to defined e-mail address when requested. Parents were provided with information over the system so that baby was not disturbed when wet and sleep was not interrupted. Baby room can be monitored by parents with camera, when baby wakes up, crib can be shaken, and baby can be re-sleeped by commanding Arduino system remotely. One of two relays used provided motor control and other relay provided heater or cooler control that was connected to the system.

Figure 9. Remote Controlled Crib Designed and Implemented

Figure 9 shows the system installed in baby crib. Arduino box and IP camera were placed on the upper right side. There is also a moisture cable extending into crib and a fan operating at 220 V on floor. This design may vary depending on area to be applied.

Web-based monitoring can be achieved by using Wi-Fi. By using a more powerful Arduino board, IP Camera can be removed from the system and a camera running directly on Arduino can be placed and image can be taken over Arduino. State of wakefulness of baby can be determined and shaking speed of crib can be adjusted by using artificial intelligence.

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