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IoT Based Ubiquitous Healthcare System

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Abstract: ***Proper medication is necessary for Type-2 diabetes patient to maintain sugar level. This is extremely problematic for the patient in every country. In recent days there have been significant advances in the field of Internet of Things (IoT) . So, we made this IoT based ubiquitous healthcare system for Type-2 diabetes patient monitoring which keeps tablet count, changes in medicine slot and providing emergency services to the patient. In particular, this concept involves load cell sensor which measures tablet weight to display the tablet count, heart beat sensor measures the patient's heart rate and location is tracked by GPS to provide emergency services. The project gives an experimental idea of patient's health condition and controlling. The feasibility of the implemented Health platform has been proven in field trials and if any vital signs recognized then gives alert to predefine care takers through SMS alert and monitor the conditions continuously with an IP address of WIFI. Hence, this healthcare system will track their medication and inform patient to take right medicine at the right time.***

Keywords: Arduino Mega, GPS, GSM, Internet of Things, Load cell sensor, LDR, LCD, remote health monitoring, wi-fi

1. Introduction

Now a days, global diabetes disease have become a common concern. Diabetes is a disease in which body is unable to properly use and store glucose. Major types of diabetes are Type 1 and Type 2. Type-1 is a chronic condition in which the pancreas produce little or no insulin .So, it is a insulin dependent . This affects the Age group of 14 to 60 years people and it is also a genetic disorder. Type-2 is a chronic condition that affects the way the body process blood sugar which is a insulin independent. This affects the Age group of 41 to 60+ years people. In this project we are mainly concentrate on TYPE 2, because this is insulin independent. Our final project is to build a Arduino based Intelligent medicine box. Our Intelligent medicine box is targeted on users who regularly take drugs and who take care of the patients. The Intelligent medicine box is programmable that allow user to specify the pill quantity at the initialization to take and the serve time for each day. When the pill quantity and serve time has been set, the Intelligent medicine box will remind users or patients to take pills using sound and light. The specific number of pills needs to be taken will be displayed by a LCD display. Our Intelligent medicine box would significantly release user's burden on frequently preloading pills for patients or users. The patient seamless healthcare at anytime in a comfortable home environment.

2. Literature Review

Taking Medicine at right time in proper amount will lead towards the faster recovery. In reality what happens is that, they get their prescribed medication but fail to follow their health care professional's instructions. Many people while taking prescript medication do not follow their doctors' instructions. Some common reasons for this are People may start feeling better and decide to not finish all of the medication. People may not notice an improvement in their symptoms right away and may stop taking the medication because they think it is not working. Some medications are expensive, and people may skip doses or take less than they were prescribed to try to save money.

2.1 The Health IoT

The in-home healthcare service enabled by the IoT technology promising healthcare industry. The Health-IoT service will speed up the transformation of healthcare from career-centric to patient-centric. Typically, a Health-IoT solution includes the following functions:

A. Information management
Enabled by the global connectivity of the IoT, all the healthcare information (tablet count, heart rate and even daily activity) can be collected, managed, and utilized throughout the entire value chain.

B. Tracking and monitoring
Identification, sensing, and communication capacity of the patient can be tracked and monitored by GPS on a 24/7 basis.

C. Emergency service
Healthcare and assist living services e.g emergency detection and first aid, stroke habitation and training, dietary and medication management, telemedicine and remote diagnosis, health social networking etc. can be delivered remotely through the internet and field devices.

D. Cross-organization integration
The hospital information systems are extended to patient home, and can be integrated into larger scale healthcare system that may cover a community, city or even state.

3. Existing System

The overall structure of the system consists of two important modules: i) Wireless Sensor Network (WSN) with Zigbee modules and ii) Intelligent home monitoring software system to collect sensor data and perform data analysis. Exploration of the sensor data involves measuring the wellness and detecting behavioural changes of an elderly. Above figure depicts the block diagram of the wellness measurement

system. Block diagram of Computer Based Wellness Measurement system A. Design of the Sensing Units: The WSN setup used for monitoring smart home consists of fabricated electrical sensing units. These are installed at an elderly home to monitor their daily activity behaviour in terms of object usages and execute effectively process. The electrical sensing units connected to various household appliances in this proposed system we implement a health monitoring platform such as temperature heart beat fall occurrence and in addition to this gives an alert message to caring persons or hospitals by using GSM technology. In addition to this an automatic environment controlling like temperature dependent fan controlling and intercity based room light controlling and the additional features to this system Medical data using a first medical data collection appliance coupled to a network, the first appliance. transmitting data conforming to an interoperable format, wherein the medical data is transmitted using a first wireless protocol.

A. Hardware Modules Used

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications. The ARM7TDMI-S core is the synthesizable version of the ARM7TDMI core, available in both VERILOG and VHDL, ready for compilation into processes supported by in-house or commercially available synthesis libraries.

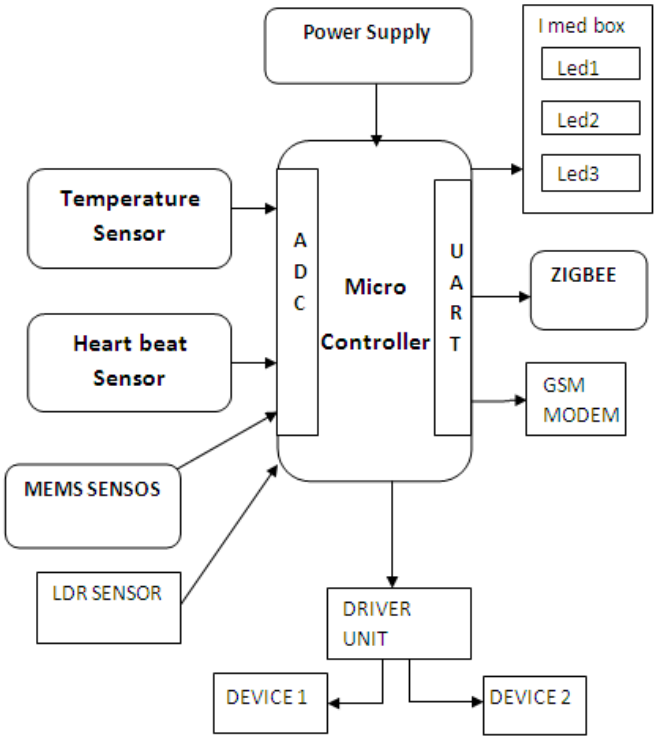

Figure 1: Block diagram

B. LPC 2148 Microcontroller

LPC2148 microcontroller board based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontrollers with embedded high-speed flash memory ranging from 32kB to 512kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. The meaning of LPC is Low Power Low Cost microcontroller. This is 32 bit microcontroller manufactured by Philips semiconductors (NXP).

C. MEMS Technology

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro fabrication technology. MEMS is an enabling technology allowing the development of smart products, augmenting the computational ability of microelectronics with the perception and control capabilities of micro sensors.

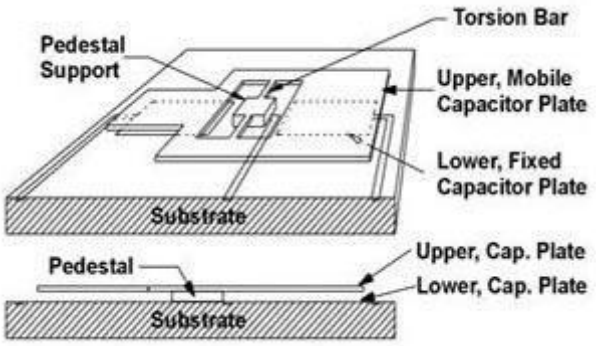

Figure 2: Mems device

The increasing demand for MEMS (micro-electromechanical systems) technology is coming from diverse industries such as automotive, space and consumer electronics. MEMS[9] promises to revolutionize nearly every product category by bringing together silicon-based microelectronics with micromachining technology, making possible the realization of complete systems-on-a-chip, first developed for the integrated circuit industry, for this emerging market.

Disadvantages of Existing System

- In this approach frequent clinical and laboratory controls were performed and the patients were given full instructions for medication and diet.
- MEMS design include very much complex procedures.
- Prior knowledge is needed to integrate MEMS device.
- Micro components are costly when compare to macro component.

4. Proposed System

a) Working

The overall structure of the system consists of the Arduino, load cell, GSM, GPS, wifi module for monitoring type2 diabetes patient to collect data and perform. In our project arduino is a processing unit. Arduino check the heart rate of the patient continuously if it is reduced imed box will automatically send text message to the take care person, hospital. If the patient takes the tablet from the tablet box, the tablet count is calculated by using load cell, count will be reduced and checks the medicine box is closed or not, LDR sense that and produce a buzzer sound.

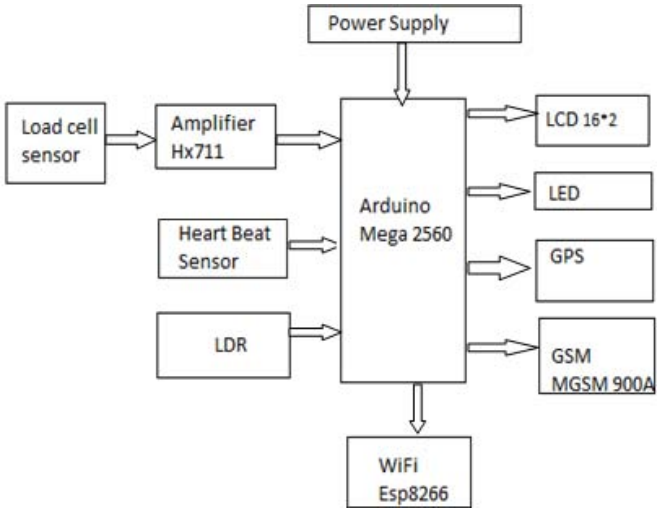

Figure 3: Block Diagram

Then the process is 3days before ending of medicine it will automatically generate previous report of the patient and that is send to the doctor. If they suggest any changes in the medicine slot that report will be send to user.

We can predict the patient heart rate of patient reduced normal level it immediately find the location of the patient by using GPS and send the message to user, emergency services by using GSM. The webpage will display the tablet count when the patient takes tablet, if not taken also with heart rate.

b) Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

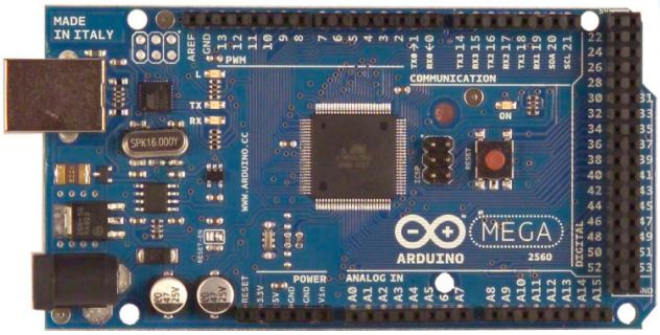

Figure 4: Arduino Mega board 2560

c) Loadcell Sensor

A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The various types of load cells include hydraulic load cells, pneumatic load cells and strain gauge load cells. Through a mechanical construction, the force being sensed deforms a strain gauge. The strain gauge measures the deformation (strain) as a change in electrical resistance, which is a measure of the strain and hence the applied forces. A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. The electrical signal output is typically in the order of a few millivolts and requires amplification by an instrumentation amplifier before it can be used. The output of the transducer can be scaled to calculate the force applied to the transducer. Sometimes a high resolution ADC, typically 24-bit, can be used directly.

Figure 5: Load cell sensor

d) Heart Beat Sensor

The Heart Beat Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through Finger. As the heart forces blood through the blood vessels in the Finger, the amount of blood in the Finger changes with time. The sensor shines a light lobe (small High Bright LED) through the ear and measures the light that is transmitted to LDR. The signal is amplified, inverted and filtered, in the Circuit.

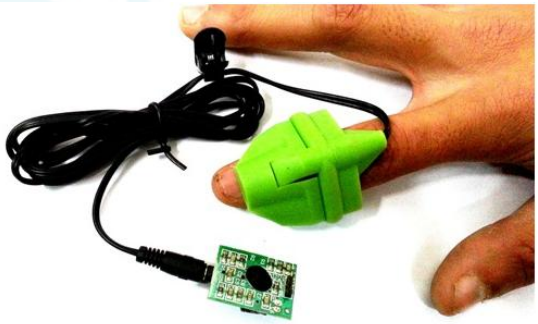

Figure 6: Heart beat sensor

e) Wifi Module ESP 8266

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed internet and network connections. Frequency range is 2.4 GHz to 5 GHz.

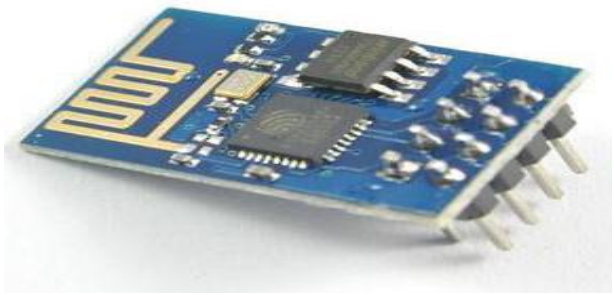

Figure 7: WIFI module ESP 8266

f) Gsm Modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a

dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. GSM SMS messaging can handle large number of transaction in a very short time. You can receive large number SMS messages on your server like e-mails without internet connectivity. E-mails normally get delayed a lot but SMS messages are almost instantaneous for instant transactions. Time you find local transaction servers busy as these servers use multiple telephone lines to take care of multiple transactions, whereas one GSM connection is enough to handle hundreds of transaction.

Figure 8: GSM module 900a

g) GPS Module

The Global Positioning System (GPS) is a satellite-based navigation system made up of at least 24 satellites. GPS works in any weather conditions, anywhere in the world, 24 hours a day, with no subscription fees or setup charges.

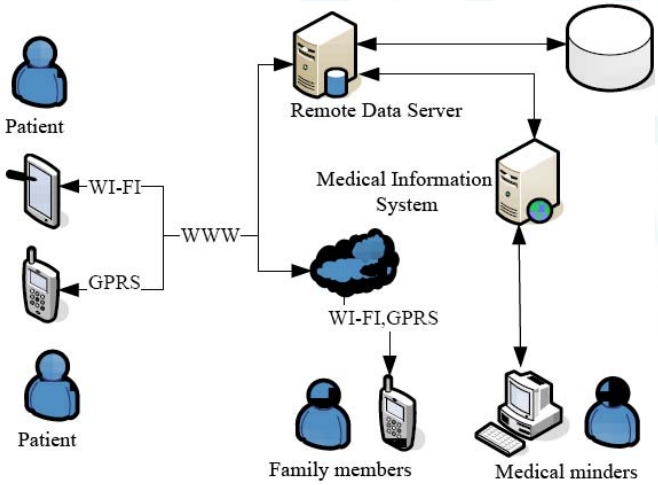

Figure 9: The overall frame work

5. Design

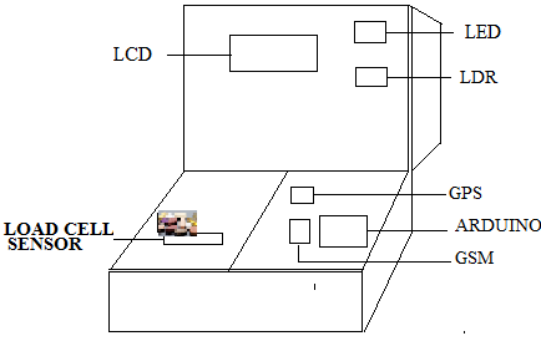

Figure 10: Output Structure

The imed box is combination of three major sections: Sensor section, report section and emergency section. The sensor board is resistive type transducer. The sensor is connected to the arduino via amplifier.There are two slots inside imed box. First slot has arduino, GSM and GPS. Second slot has load cell sensor. The imed box lid contain LCD, LDR and LED.

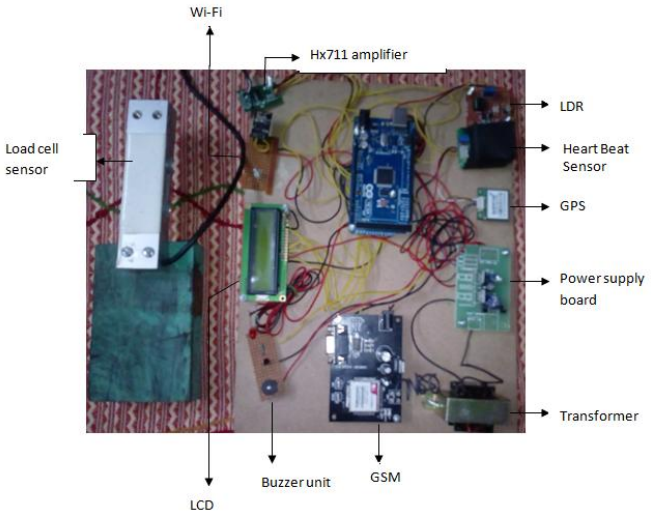

Figure 11: Hard ware Display

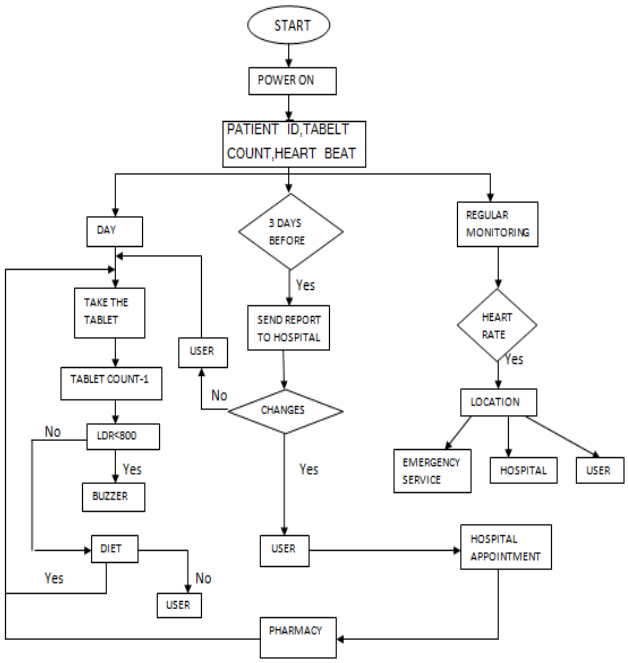

Figure 12: Flowchart

6. Results and Discussion

Figure 13: LCD module used

Figure 14: Displayed sentence in LCD

Figure 15: When sending message to the user

Figure 16: After sending the message

Figure 17: The remaining tablet count

Figure 18: Data's shown in webpage

7. Application Scenario

The center of the system is a powerful intelligent medicine box (iMedBox), which works not only as a traditional in-home medicine container (such as a drawer of cabinet, a thermostat or an icebox), but also as a "medication inspector" in daily monitoring. On one side, it is linked to public area (e.g. the hospital, the user and the emergency help center) through wireless internet. On the other side, it counts the tablets and a suit of wearable biomedical sensor (load cell sensor, heart beat sensor) through GSM.

Figure 18: System usage

8. Conclusion and Future work

In this paper, a preventive medication management solution addressing the medication noncompliance problem is proposed. A prototype system is implemented which confirms the feasibility of the presented intelligent pharmaceutical packaging and intelligent medicine box. This includes features for creating a user manual remote access to this box; choosing a larger LCD display; using a metal to cover the entire circuitry; placing the switch and LED displays on the surface of the box and using larger boxes.

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