

WET DIAPER ALERT SYSTEM FOR BEDSIDE PATIENTS WITH WIRELESS COMMUNICATION TO NURSING STATION VIA SMART DIAPER MOBILE APPLICATION

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Abstract— The recent statistics places on record the wide usage of diapers by adults. According to the data available in Diaper bank Network, more than 2 million adults are using diapers. Especially, patients under post surgery care use diapers, and periodical monitoring of this is challenging. The main objective of this proposed work is to develop an alert system for change of diapers. This is a wireless alert system via a mobile application to the nursing station, when the diapers of the bedside patients are wet and needs a change. The sensors are just flat and flexible cables that detect the conductivity. Sensors are strategically placed at three different layers of the diaper. First sensor is placed between Waterproof and Extra absorbent layer for easy and early detection of the fluid. Second sensor and third sensor is placed between extra absorbent layer and wick away liner. When the diaper is fully wet, an alert is send to the nursing station indicating change of diaper.

Keywords— Conductivity, Wireless Alert, Mobile Application

I. INTRODUCTION

In modern days, where health and hygiene go hand in hand, it is essential to care for elders, who are in the urge of using Adult Diapers. There is a need and a desire to have a diaper that somehow alerts a caretaker when it is time to change. In hospitals, patients under post surgery care usually wear diapers; hence it is essential to alert the nurses in their mobiles when the diaper is fully wet. The message is send with identification, which will be the bed number. Hence for continuous monitoring of bed side patients this alert system will assist the attendants by making their job easy.

The sensor which is a thin wire strip is embedded in the diaper and the sensor can be plugged to the wireless transmission unit attached to the bed. . The Wi-fi module can be fixed in every beds and the sensor cable has to be attached to the Wi-fi module, every time the diaper is changed. This detachable transmission unit can considerably reduce the cost of the diaper.

II. METHODOLOGY



Figure 1. Block Diagram

HARDWARE DETAILS

A. Sensor

A sensor is a device which detects or measures a physical property. The working of the sensor is based on the principle of conductance Conductance can be expressed by the ease with which current flows through a substance. Conductance is symbolized by letter G. The standard unit of conductance is mho.

$$G=1/R$$

Where G is conductance

R is resistance

B. RMC Connector

Relimate Connector (RMC) is used to connect many wires each to their corresponding connecting points at once. The wires are attached to this connector which resembles ribbon cable, but are completely separated from each other. The wires can be attached to the male connector by crimping them into the metallic plates which is present in the outer plastic slots. The metal strip shown in the third row of the above image is cut off into individual pieces and wires are crimped into them, After which the wires are inserted into the RMC slots. The male and female connectors are polarized, means they have matching projections on them which allows them to be connected in only a single orientation.

C. Sensor Positioning

Sensor is placed at two positions. One sensor is kept between Waterproof and Extra absorbent layer for easy detection of the fluid. Second sensor and third sensor is placed between extra absorbent layer and wick away liner for the further detection of the fluid.

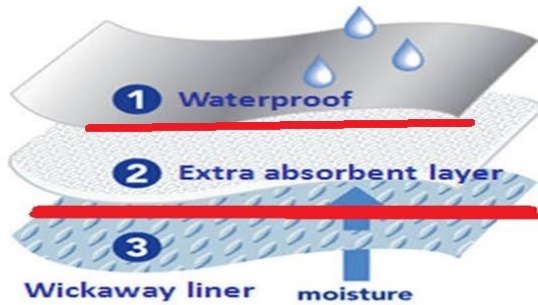


Figure 2 Layers in Diaper

D. Transistor Switching Circuit

A transistor is a semiconductor device used to amplify, switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A current applied to one pair of the transistor terminal controls the current through another pair of terminals. There are two types of transistors bipolar terminal labeled as base, collector and emitter and FET transistor has the terminals labeled gate, source and drain.

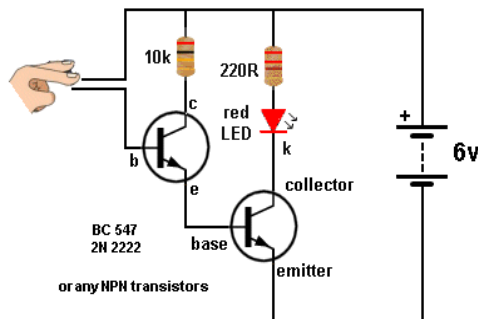


Figure 3 Transistor Switching Circuit

The figure shows the Common Emitter circuit. Here the transistor works as a switch. The transistor needs to be turned either fully "OFF" (cut-off) or fully "ON" (saturated). Ideally, transistor switch should have infinite circuit resistance between the Collector and Emitter when in "fully-OFF" mode resulting in zero current flowing through it and zero resistance between the Collector and Emitter when in "fully-ON" mode, resulting in maximum current flow.

The sensor outputs are connected to the transistor base to switch it ON based on the conductivity.

E. WIFI module

The ESP8266 is a microcontroller built by Espressif Systems that has WiFi built in. There are a variety of methods to program the ESP8266 including:

- AT (terminal) commands
- Official ESP8266 SDK and Toolchain
- NodeMCU with eLua
- Arduino IDE

Programming of ESP8266 in Arduino was adopted for this work which provides access to most of the libraries found in the Arduino IDE environment as well as a very well understood development process for IoT devices. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

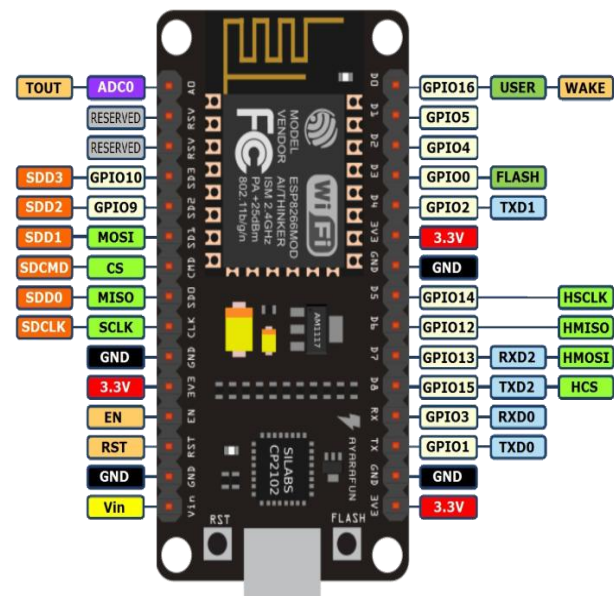


Figure 4 PIN details of ESP8266

Features

- Arduino-like hardware IO:

The arduino board is based on open source firmware NodeMCU which is an advanced application programming interface for hardware IO. It dramatically reduces the redundant work for configuring and manipulating hardware. The board allows you to code like Arduino in an interactive manner with the Lua scripting language.

- NodeJS style network API:

The firmware provides API for network applications, which helps developers in writing code running for the tiny little board in NodeJS style. Greatly speed up your wifi / IOT application developing process.

- Lowest cost WIFI development tool:

It is extremely easy to prototype development kit in breadboard since it is easier to work on it from economical point of view.

- Reprogramming possibility:

IO button available on the kit also functions as a re-flashing button for the wifi module. The module can be re-flashed with either nodemcu firmware or standard AT command set firmware.

- Multiple uses:

This development kit not only can be used for wifi development but can also be used as a simple USB to serial converter as well as LiPo battery charger on stand-alone basis. This means, you get functionality of 3 into one.

Specification

- Integrated low power 32-bit MCU
- Integrated 10-bit ADC
- Integrated TCP/IP protocol stack
- Integrated TR switch, power amplifier and matching network
- Integrated PLL, regulators, and power management units
- Supports antenna diversity
- Wi-Fi 2.4 GHz, support WPA/WPA2
- Support STA/AP/STA+AP operation modes
- It has SLF(smart link function) which works on both Android and iOS devices
- STBC, 1x1 MIMO, 2x1 MIMO

III. SOFTWARE DESCRIPTION

F. Arduino IDE

The coding and the the dumping of the program to the board is made easier by using the open-source Arduino Software (IDE) .Java is used as the platform for writing the code and for the other open source applications.

SOFTWARE IMPLEMENTATION

Algorithm

- Initialize the SSID and password
- Initialize the pin
- Initialize the variable
- Create an instance of the server
- Specify the port to listen on an argument
- Prepare GPIO2
- Connect to Wifi Network
- Print the IP address
- Wait until the client sends some data
- Read the first line of the request

- Match the request
- Set GPIO2 according to request
- Convert the response to string format
- Send the response to client

Table 1 Tabulation for different volume of water at different positions

Curved	Horizontal	Reading
150 ml	80 ml	30%
230 ml	180 ml	60%
370 ml	300 ml	100%

RESULTS



Figure 5 Final Output When sensing is being completed by three sensors alert message will be delivered to the corresponding device.



Figure 6 displays the status of the diaper as dry when the diaper is not wet by the liquid.



Figure 7 displays the status of the diaper as wet when it is completely wet and it is ready to change

CONCLUSION AND FUTURE SCOPE

Proper removal of diapers for beded patients keeps them away from urinary infections so this concept provides easy detection of urine in diapers and helps to avoid urinary infections to the patients.

Using ESP8266 which include the active wifi transmission helps the product to be smart. User can receive sufficient data in their smart device any time. The circuit used makes the entire mechanism simple.

Since simple wires are used as sensing elements the entire product can be manufactured at low cost which is affordable for common people. The diaper is specifically designed for hospitals and elderly care units, where the focus is on the low cost of production, and also the increase quality of service for the patients. The diaper system is well suited for incorporating into existing intelligent health care systems.

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