VACCO-COOL

(IOT based Vaccine/medicare Cooling Box)

[1]Saurabh Jiwal, [2]Tarun Sharma, [3]Mrs.lily Gupta
Assistant Professor
Electronic and Communication
Dronacharya Group of Institutions
Greater Noida, U.P

Abstract— With the development of economies, Government has been paid more and more attention in the healthcare field. This project paper introduces an Internet-of-Things-based vaccine box cooling monitoring and management system, consisting of sensing, transportation, storage and application layers which have different functions. This system implements the vaccine box cooling - monitoring and service-provision anywhere and anytime, and community-centered healthcare services.
Solar power is the most economical way to power a system. The vaccine box need power to keep the vaccine's cool to power the system uses the solar power.
And as we know that, Most IoT platforms have been developed in an effort to be universally applied to various services and applications. However, critical success factor of IoT is an explosion of demand for services. Therefore, the goal will be achieved if the service and the application are reflected their characteristics for each use case. Hence, we implemented an IoT platform based vaccine box cooling management system titled Vacco-Cool.

Keywords—Internet of Things (IoT), cloud (thing speak), Arduino, sensor, Vaccine, Cooling, Wi-Fi, Solar Panel.

I. INTRODUCTION

In India, one third of children are not vaccinated and they got wasted as the environment is not optimal (temperature is not within the expected range). As we know that 25% of vaccines go waste even before reaching the doctors and patients because of various factors like transportation, poor temperature management, frequent power outage and lack of monitoring system. Keeping in view of the above-mentioned problems, we are trying to develop a project which cans surveillance and manages the temperature as well as it will sort the problem of frequent power outage. Through this we can improve the efficacy of vaccine. Best part of the project is that the data can be analyzed by the mobile application and handle the crisis situation effectively.

IoT (Internet of Things) is a currently advanced concept of ICT (information communication technology), in which all devices and services are collaborating to monitor and manage the logistics temperature of cold chain in immunization program. The Gartner which is one of market research firms expected that IoT has been ranked in the top future promising technology. In addition, healthcare service is making the application and development of the currently most active IoT technologies.

It provides a solution of measurement of vaccine box temperature, moisture. A very simple GUI Interface is provided for reading all the parameters in the mobile/web or at anywhere in the world by using internet connectivity. In this project, we are using various sensors and modules for performing different type of applications and the Thing speak Cloud service is used for storing all the data in cloud, it provides security and facility of accessing all the parameters at any time. This system also generates an alert when it required that means at the time of any critical conditions and notifications about the medicines, conditions etc.

II. LITERATURE REVIEW:

Many medications which are prescribed to be taken on a daily or regular basis must be kept in a controlled-temperature environment. Such medications include insulin, antibiotics reconstructed in sterile water, allergy and other serums, vaccines, suppositories, snake anti-venom, and many others. If the temperature of such substances is not carefully controlled, they lose their stability and potency, and may in fact present health hazards. For example, insulin which is currently available must be maintained at 34° F.-86° F.; the insulin becomes unsafe for use if permitted to warm to a temperature above 86° F.

Heretofore, refrigerated containers have been available for preserving insulin and other similar medications during travel. However, most such devices have in the past merely been passive insulated containers filled with blocks of ice or frozen gel packs which are refreezable in a freezer compartment of a refrigerator. Active devices have been suggested, but they are generally complex, expensive, and lack the features of the present invention. The contents of U.S. Pat. Nos. 3,148,515; 3,713,302; and 4,407,133 are expressly incorporated by reference.
Accordingly, there is a need for a portable IOT based thermoelectric vaccine cooling box which is simple in design and construction yet effective in performance and which contains the features of the present invention, including a monitoring and maintenance service.

III. COMPONENT AND MODULE STUDY

1) Arduino UNO:
Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, 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 1 Arduino Uno

Technical Specifications:

Microcontroller	Atmega 328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8
DC Current per I/O Pin	40 mA
Flash Memory	32 KB of which 0.5 KB used by bootloader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

2) DHT11

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

TECHNICAL DETAILS

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50°C temperature readings ±2°C accuracy
- No more than 1 Hz sampling rate (once every second)
- Body size 15.5mm x 12mm x 5.5mm
- 4 pins with 0.1" spacing

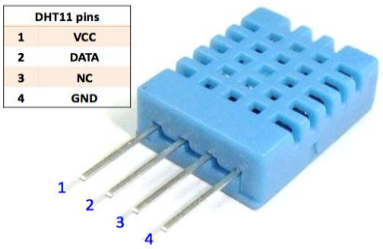

Figure 2 **DTH11 Module**

3) WiFi Module

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existance interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

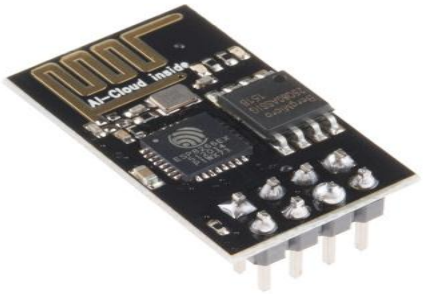

Figure 3 Wifi Module

TECHNICAL DETAILS

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLLs, regulators, DCXO and power management units
- +19.5dBm output power in 802.11b mode
- Power down leakage current of <10uA
- 1MB Flash Memory
- Integrated low power 32-bit CPU could be used as application processor
- SDIO 1.1 / 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)

4) Relay Board

The Single Relay Board can be used to turn fans and other devices on/off while keeping them isolated from your microcontroller. The Single Relay Board allows you to control high-power devices (up to 10 A) via the on-board relay. Control of the relay is provided via a 1 x 3 header – friendly to servo cables and convenient to connect too many development boards.

Figure 4 Relay Board

TECHNICAL DETAILS

- Voltage requirements: 5 VDC (Relay Power), 3.3-5 VDC (Input Signal)
- Current requirements: ~85 mA (Relay Power)
- Communication: Logic High/Low (3.3–5 VDC)
- Dimensions: 1.57 x 1.06 x 0.71 in (4.0 x 2.7 x 1.8 cm)
- Operating temp range: -13 to +158 °F (-25 to +70 °C)

5) Thermo-electric cooler module

Thermoelectric coolers (TEC or Peltier) create a temperature differential on each side. One side gets hot and the other side gets cool. Therefore, they can be used to either warm something up or cool something down, depending on which side you use. This Peltier works very well as long as you remove the heat from the hot side. After turning on the device, the hot side will heat quickly, the cold side will cool quickly.

Figure 5 Thermo-electric cooler Module

TECHNICAL DETAILS

- 40 x 40 x 3.6mm
- Imax - 7A
- Umax - 15.4V
- Qcmax - 62.2W
- Tmax - 69C
- 1.7 Ohm resistance
- 127 thermocouples
- Max Operating Temp: 180°C
- Min Operating Temp: -50°C

6) Liquid Crystal Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

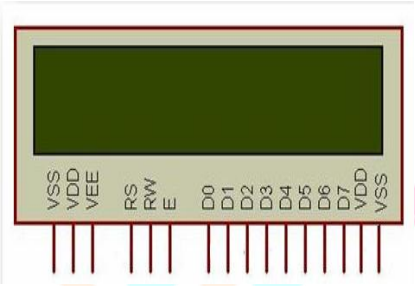

Figure 6 16x16 LCD

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

IV. CIRCUIT DIAGRAMS

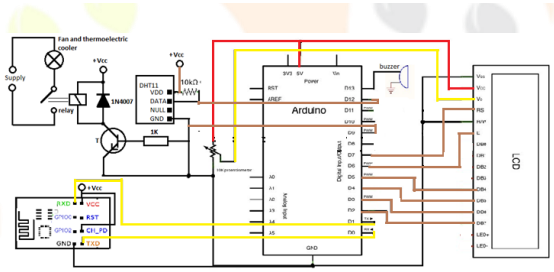

Figure 7

Connections of the sensors and modules with Arduino NANO

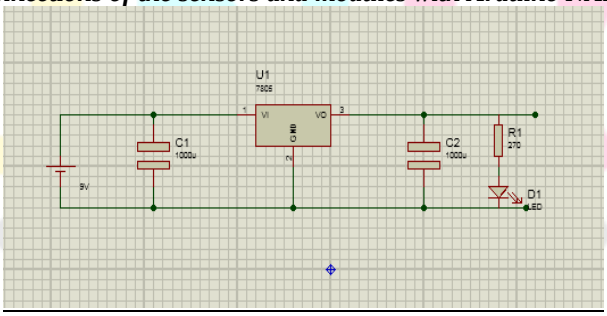

Figure 8

Circuit Diagram of Power Section

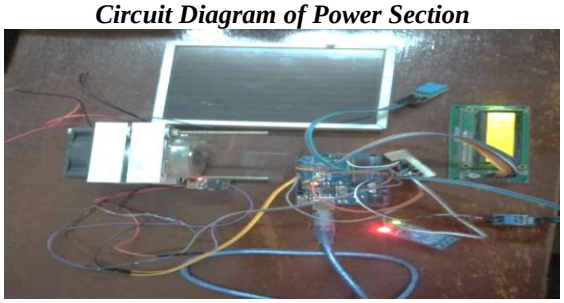

Figure 9

Prototype

V.SOFTWARE/PROGRAMMING LANGUAGE:

Arduino IDE:

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

PROGRAMMING LANGUAGES:

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub main() into an executable cyclic executive program:

Setup(): a function that runs once at the start of a program and that can initialize settings.

Loop(): a function called repeatedly until the board powers off.

After compiling and linking with the GNU toolchain, also included with the IDE distribution, the Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

VI.: RESULT/OBSERVATION , CONCLUSION & FUTURE SCOPE

OBSERVATION

Figure 10 Hardware Data

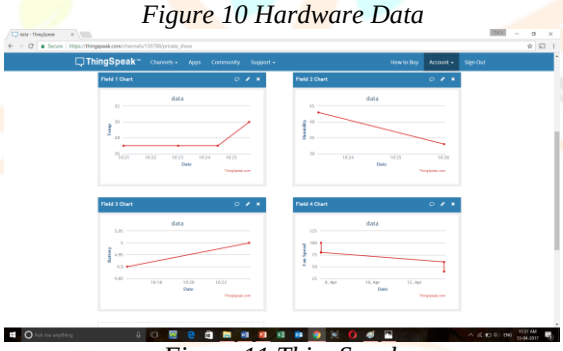

Figure 11 ThingSpeak

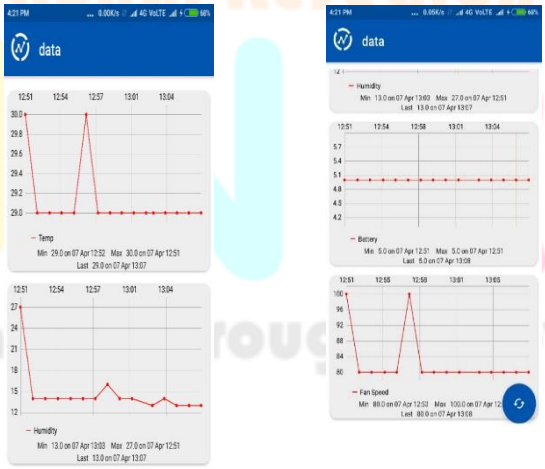

Figure 12 Mobile View

VII CONCLUSION:

Through portable IOT based thermoelectric vaccine cooling box we can improve the efficacy of vaccine as it provides a solution of measurement and controlling of vaccine box temperature, moisture.

Sensor data is processed in an anomaly detection algorithm inside the Arduino board and if it detects environment anomaly, the buzzer starts sounding and alert will be generated through IOT.

Data can be analysed on the mobile application and handle the crisis situation effectively.

VIII FUTURE SCOPE:

For more reliable and low complexity of the system the controller section can be replaced by other Advanced Microcontrollers. The applications can be added by adding the more modules and sensors.
Accuracy can be increased by using high sensitive sensors and more reliable modules.
For more security and functionality in the cloud can be increased by using paid clouds or won cloud.

XI. REFERENCES:

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