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Design of Vaccine storage and transportation in remote areas

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ABSTRACT: Vaccination can not only effectively protect individuals from infectious diseases, but also effectively prevent the spread of infectious diseases. The storage and transportation of vaccines have very high requirements on the environment. This project designs an intelligent vaccine storage and transportation system. The system has the functions of process monitoring, storage and transportation traceability, temperature control and vaccine transfer. It combines software and hardware, and is suitable for remote areas. It aims to provide "last mile" service for children who need vaccination in remote areas. Vaccination is the assured way of gaining immunization against many life-threatening diseases. However, the vaccine outreaches in developing and undeveloped countries are very limited due to lack of proper management of the cold chain system. This paper presents a real-time data-centric cold chain monitoring system for the continuous monitoring of the vaccine distribution and transportation process. The proposed system provides the unique feature of creating and managing individual trips for vaccine transportation process along with the regular supervision of temperature and humidity of the carrier. Moreover, the hardware and software components for the system also track the location of the carrier. This proposed system can be particularly highly effective in increasing vaccine coverage in the remote regions. This is because the proposed system enables the remote monitoring of the entire process and ensure transparency in the distribution process..

KEYWORDS: Internet of things, Sensor, ESP-8266, cold chain monitoring

I. INTRODUCTION

In recent years, the integration of Internet of Things (IoT) technology in various applications has been gaining popularity, including the management of public toilets in societies. IoT-enabled monitoring and controlling systems have emerged as a promising solution for addressing the challenges associated with the maintenance of public toilets in societies.

Immunization by vaccines is widely acknowledged for controlling and eliminating a large number of infectious diseases and is also one of the most cost-effective public health interventions. According to UNICEF, vaccines are saving 2-3 million lives every year. However, vaccine outreach is still very limited in the developing and undeveloped countries. In 2018 alone, 13.5 million children did not receive routine immunization and 1.5 million lives are lost every year from diseases that can be prevented by vaccines.

[1]. Even though different factors are responsible for this low outreach of vaccines, breach of the vaccine cold chain is the biggest contributing factor.

[2]. Vaccines are extremely sensitive to temperatures. The World Health Organization has fixed the temperature range for vaccine storage and transportation as 28°C and vaccines completely lose potency if they are exposed to temperatures beyond this range even for short durations. This is why maintaining the cold chain system from the point of manufacture till the point of administration is very important. However, various physical, geographical and socio-economic factors in the developing countries hamper the smooth management of the vaccine cold-chain system resulting in the loss of almost 50% vaccines annually.

[3]. WHO has a number of standardized devices and guidelines for monitoring the cold chain; but in the undeveloped countries, about 31% of these devices were non-functional and several of the units were too old for use.

[4]. Most of the people in the undeveloped and developing countries are not sufficiently trained for

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using these devices and often times there is no transparency and no routine monitoring in the cold chain system. This leads to the wastage of almost 39.54% vaccines at the session sites. Moreover, while transporting, the vaccines are mostly carried in cold boxes using ice packs and cold water packs. The vaccines often freeze below the necessary temperature range rendering them useless and even harmful. Again, because of the lack of accountability, vaccines even get lost or stolen during the journey to the health centers. All these contribute to the loss of almost 30% vaccines during transportation.

[5]. Considering these existing problems in maintaining the cold chain, this paper introduces a real-time, data-centric vaccine cold chain monitoring system, which monitors the temperature and location of the vaccine carriers and sends necessary notifications and text messages to the healthcare supervisors accordingly. The corresponding hardware designs for the system have been previously developed which consists of a thermoelectric based vaccine carrier, a monitoring module containing the necessary temperature and humidity sensors and a communication unit which is responsible for providing the location information as well as for sending text notifications and sharing data on the web server.

[6]. This system ensures that transparency is maintained and that the vaccines are monitored routinely throughout the transfer process. Unlike traditional systems, the entire monitoring process is carried out automatically, hence there is no space for human errors or negligence. The different design aspects and features of the system are described in details in this paper.

II. SYSTEM DESIGN

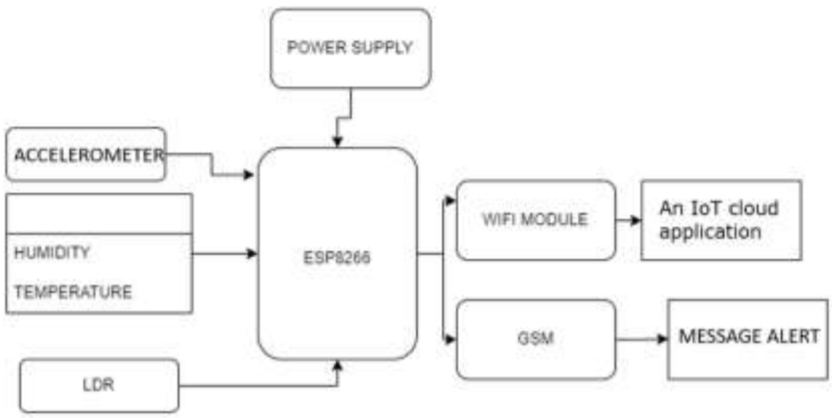

Fig. 1. SYSTEM DESIGN FOR IOT ENABLED VACCINE STORAGE AND TRANSPORTATION SYSTEM

The Internet of Things (IoT) describes the network of physical objects "things" that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools. With more than 7 billion connected IoT devices today, experts are expecting this number to grow to 10 billion by 2020 and 22 billion by 2025.

IoT (Internet of Things) technology is a network of interconnected physical devices, vehicles, buildings, and other objects that have sensors, software, and connectivity that allow them to collect and exchange data. The IoT technology aims to enable intelligent communication between physical objects, which allows them to share information, make decisions, and automate tasks without human intervention.

1HARDWARE DESCRIPTION

1.1 ARDUINO UNO

Arduino Uno as in figure 1.1.1 is used which 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 ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a

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reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

Figure1.1.1

1.2 LCD

LCD as in figure 5.2.1 is used as a type of display technology used in various electronic devices, including digital watches, calculators, televisions, computer monitors, and microcontroller-based projects like Arduino. An LCD consists of a layer of liquid crystal material sandwiched between two polarizing filters. When an electric current is applied to the liquid crystal layer, the crystals align themselves in a way that allows light to pass through the second polarizing filter, creating visible characters or images. LCDs are commonly used in microcontroller-basedprojects to display information such as sensor readings, menuoptions, and other output. They are available in various sizes and resolutions, and some also come with built-in controllers that simplify their interfacing with microcontrollers like Arduino. To use an LCD with Arduino, you will typically need to connect its pins to the appropriate pins on the Arduino board, and then use an LCD library to control the display. There are several libraries available for this purpose, including the LiquidCrystal library that comes with the Arduino IDE. The library provides functions to display characters, clear the screen, set the cursor position, and other basic operations

Figure 1.2.1

1.3 LM35

LM35 as in figure 5.3.1 is used as a precision temperature sensor that is commonly used in electronic projects. It is an analog sensor that can measure temperature in the range of -55°C to 150°C with an accuracy of ±0.5°C. The LM35 sensor works by outputting a voltage that is proportional to the temperature it measures. Specifically, the output voltageCelsius increase in temperature. For example, if the temperature is 20°C, the output voltage of the sensor will be 200 millivolts. To use the LM35 sensor with an Arduino board, you would typically need to connect the sensor's output pin to one of the analog input pins on the Arduino board, and then use the analogRead() function to read the sensor's output voltage. Where sensorPin is the analog input pin connected to the LM35 sensor, and 5.0/1023.0 is a scaling factor that converts the sensor's output voltage to a value between 0 and 5 volts. LM35 is a widely used temperature sensor due to its simplicity, accuracy, and ease of use with microcontrollers like Arduino. It is commonly used in temperature monitoring and control applications, such as thermostats, incubators, and HVAC systems.

III. IMPLEMENTATION

Figure1.3.1

1.4 DHT

DHT11 as in figure 1.4.1 is used as a temperature and humidity sensor that is commonly used in electronic projects. It is a digital sensor that can measure temperature in the range of 0°C to 50°C with an accuracy of ±2°C, and relative humidity in the range of 20% to 80% with an accuracy of ±5%.The DHT11 sensor works by outputting a digital signal that represents the temperature and humidity it measures. Specifically, the sensor outputs a 40-bit data stream that includes the temperature and humidity values in binary format. To use the DHT11 sensor with an Arduino board, you would typically need to connect the sensor's data pin to one of the digital input/output pins on the Arduino board, and then use a library

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such as the DHT library to read the sensor's output data. The library provides functions to read the temperature and humidity values from the sensor, and also includes error checking and retries to ensure reliable data transmission. DHT11 is a widely used temperature and humidity sensor due to its low cost, simplicity, and ease of use with microcontrollers like Arduino. It is commonly used in environmental monitoring and control applications, such as weather stations, greenhouses, and indoor air quality monitors.

Figure1.4.1

1.5 LDR

Based on the materials used, photo resistors can be divided into two types: intrinsic and extrinsic. Intrinsic photoresistors use undoped materials such as silicon or germanium. Photons that fall on the device excite electrons from the valence band to the conduction band. This creates more free electrons in the material that are available to carry current, and therefore less resistance. Extrinsic photoresistors are made of materials doped with impurities, also called dopants. The dopants create a new energy band above the existing valence band, populated by electrons. These electrons need less energy to make the transition to the conduction band thanks to the smaller energy gap. The result is a device sensitive to different wavelengths of light. Regardless, both types will exhibit a decrease in resistance when illuminated. The higher the light intensity, the larger the resistance drop is. Therefore, the resistance of LDRs is an inverse, nonlinear function of light intensity.

Figure1.5.1

1.6 ACCELEROMETER

Accelerometer sensors have the ability to alter obtained physical acceleration from motion or gravity into a voltage output. Accelerometers are widely used to measure inert acceleration due to gravity, the low-frequency module of the acceleration and the dynamic acceleration due to animal movement [36]. The usage of 400 accelerometers for studying the grazing behavior of cattle was reported by several scientists. Andriamandrosoetal. [48] used smartphone inertial measurement units (IMUs) to count the number of bites through a frequency pattern of single-axis acceleration data. Oudshoorn et al. [49] were the primary group of researchers to use a three-axis accelerometer to calculate cow bites. The technique involves visualization of the obtained signals from the three individual orthogonal axes to determine that the best signal matched with the recorded bites. However, this approach, indicated an average correlation coefficient of 0.65. Umemura et al. were able to observe the jaw movements by altering a pedometer into a pendulum and fixing it to the lower jaw. The data obtained from the device was transferred wirelessly and it showed 90% accuracy in measuring jaw movements when compared to manual counts over 10-minute sections [50].

One of the vital features of accelerometers is the sensitivity of the signals documented. Unwanted signals obtained due to swift head or ear movement can hinder the data interpretation; hence a preprocessing of the signal relative to the jaw movements is necessitated for the benefit of precision livestock farming (PLF). Remarkably, the IMUs, which associate numerous sensors like accelerometers, gyroscope, magnetometer, and GPS, ultimately offer actual benefit in terms of multiple-parameter data related to animal feeding behavior and animal location (active or not). Fig. 27–6 shows the main components of multiparametric sensors installed for PLF. These multiparametric sensors gather and assimilate the data obtained from individual sensors to deliver a complete health description of individual animals, as well as herd behavior. These sensors have the ability to forecast farm animal disease. During disease outbreak, multiparametric sensors can support the identification and segregation of infected livestock prior to the spread of outbreak and potentially prevent needless removal of uninfected animals, as practiced in existing animal farming [34].

Figure1.6.1

1.7 GSM MODULE

GSM Module with Arduino. There are different kinds of GSM modules available on the market. We are using the most popular module based on Simcom SIM900 and Arduino Uno for this tutorial. Interfacing a GSM module to Arduino is pretty simple. You only need to make 3 connections between the gsm module and Arduino. Solet's get to business!A GSM Module is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach the mic and speaker, to take out +5V or other values of power and ground connections. These types of provisions vary with different modules.

Lots of varieties of GSM modems and GSM Modules are available in the market to choose from. For our project of connecting a gsm modem or module to Arduino and hence sending and receiving SMS using Arduino.

Figure1.7.1

1.8 GPRS MODULE

NEO-6M GPS Receiver Module

Global Positioning System (GPS) makes use of signals sent by satellites in space and ground stations on Earth to accurately determine its position on Earth.

The NEO-6M GPS receiver module uses USART communication to communicate with microcontroller or PC terminal.

It receives information like latitude, longitude, altitude, UTC time, etc. from the satellites in the form of NMEA string. This string needs to be parsed to extract the information that we want to use.

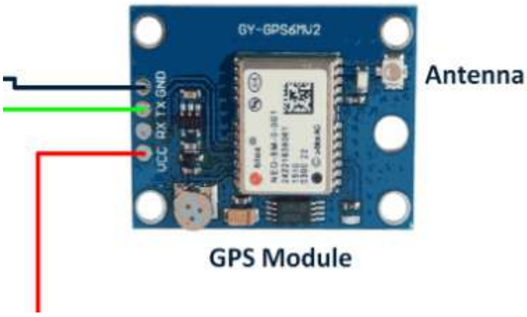

Figure1.8.1

III. SOCIAL IMPACT

Vaccination is the assured way of gaining immunization against many life-threatening diseases. However, the vaccine outreaches in developing and undeveloped countries are very limited due to lack of proper management of the cold chain system. This paper presents a real-time data-centric cold chain monitoring system for the continuous monitoring of the vaccine distribution and transportation process. The proposed system provides the unique feature of creating and managing individual trips for vaccine transportation process along with the regular supervision of temperature and humidity of the carrier. Moreover, the hardware and software components for the system also track the location of the carrier. This proposed system can be particularly highly effective in increasing vaccine coverage in the remote regions. This is because the proposed system enables the remote monitoring of the entire process and ensure transparency in the distribution process.Proper vaccine storage and handling practices play a very important role in protecting individuals and communities from vaccine-preventable diseases. Vaccine quality is the shared responsibility of everyone, from the time vaccine is manufactured until it is administered**.**

IV. RESULT

An app based monitoring system for vaccine cold chain is proposed in this system. The proposed system ensures that the vaccine cold chain is monitored continuously during the entiretransportation process to health centers and as the system is completely automated, it ensures transparency and efficiency in the whole process. The system can be extremely beneficial when utilized to track and monitor the vaccine transfer processes in the remote areas in developing and undeveloped countries where the vaccine outreach is minimum due to lack of proper management of the cold chain systems. Even though there are no visible drawbacks of the system, there are still some future scopes in improving the overall efficiency of the application by making it as user friendly as possible to be easily usable by the untrained field workers and add features as necessary.

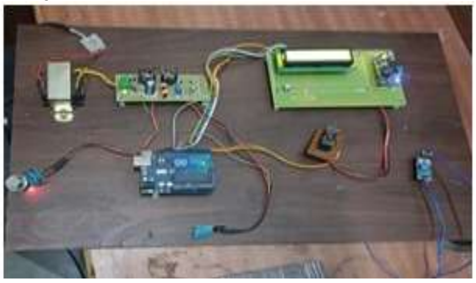

Figure4.1

V.CONCLUSION

In conclusion, the wireless vaccine monitoring system is a highly effective and efficient way to monitor and control the environment within a vaccine container. By utilizing sensors and communication technologies such as Arduino Uno, DHT11, LDR, Accelerometer and ESP8266, the system collects and transmits data in real-time, allowing for timely adjustments to be made to the container environment. The wireless vaccine monitoring system helps maintain optimal environmental conditions for plant growth by monitoring temperature and humidity levels. It also automates systems. The remote access feature of the system enables monitoring and control of the vaccine container environment from anywhere in the world.

Even though there are no visible drawbacks of the system, there are still some future scopes in improving the overall efficiency of the application by making it as user friendly as possible to be easily usable by the untrained field workers and add features as necessary.

VI. ADVANTAGES

To improve the level of cold chain temperature monitoring management.

The system combines software and hardware, and has the functions of process monitoring, storage and transportation traceability and vaccine transfer.

Alert message will be populated to the user, when the particular vaccine's temperature will be goes high or low.

To alert the concern provider if temperature increases, if vaccine container is not in correct position, if light intensity level increases

REFERENCES

[1]. LE Imbelloni , IAN Pombo, GBDM Filho. NATIONAL GUIDELINES FOR VACCINE STORAGE AND TRANSPORTATION. EBSCO, 2015, 10. 5658/WOOD.2015.43.1.17.

[2]. Yong Sun, LiqingGeng ,KeDan . Design of Smart Mirror Based on Raspberry Pi. ICITBS 2018, 77-80.

[3]. Zhang Jing. A simple calibration methods of relative humidity sensor DHT22 for tropical climates based on Arduino data acquisition system. IMAT, 2019.

[4]. J Liu, M Tang, Y Geng , Adaptive Spray and Wait Routing Based on Relay-Probability of Node in DTN. International Conference on Computer Science & Service System, 2012.

[5]. Liao Yingjun ,NiuLin, Cai Liulu . Design and implementation of vaccine storage and transportation system based on RFID Technology. Computer knowledge and technology, 2018. 1009-3044radio2018限30-0071-03.