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Real-Time Monitoring and Controlling of Refrigerated Truck Using IoT

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Abstract: ***Transportation is an important part of food chain, aiming at monitoring the temperature, humidity inside the refrigerator trucks and tracking the location of the refrigerator trucks. In this system, we have designed an intelligent monitoring system based on the Internet of thing, realized monitoring temperature and humidity inside the refrigerator trucks , and tracking the location of refrigerator trucks real-time in the entire transportation process by using advanced technologies like MQTT, Cloud Computing, sensor technology and the***
wireless communication technology. The proposed system uses an ESP32 as main control unit, DHT22 , proximity sensor, RTC, and GSP module. The system is very capable to monitor refrigerated truck from anywhere and anytime using a mobile application. This system is capable of monitoring data which can be displayed through mobile application and if any problem is detected the issue can be solved by human intervention. We can achieve good results of data monitoring such as temperature, humidity, door status and location with MQTT protocol. It is satisfied with the performance through the analysis of monitoring system and experiment results for the designed refrigerated truck monitoring system. Moreover, this proposed system has main advantages which minimizes the human efforts for the manual monitoring and product loss due to uncontrolled environment.
Keywords: Refrigerator Trucks, Internet of Things, MQTT, ESP 32, Live GPS Location

I. INTRODUCTION

On 25st march 2020, world came to a standstill as it witnessed something which never happened in almost 100 years, WHO officially declared a pandemic and we were locked inside our houses wondering what could be done to return to normal lives, thanks to our scientist, who came up with the vaccines in shorter time but again a big problem which was faced by most countries were the transportation of vaccines from one city or country to another, with transportation not a big issue but the requirement of vaccines in which it was to transferred, so basically what are vaccines, Vaccines are a special kind of drug, the quality of which is highly sensitive to temperature. Recently, numerous vaccine-related adverse events have occurred in the world, especially in developing countries, due to vaccines being exposed to inappropriate temperatures during their transportation, Vaccines may lose their effectiveness if they become too hot or too cold at any time. Vaccines naturally biodegrade over time, and storage outside of the recommended temperature range – including during transport – may speed up loss of potency, which cannot be reversed. This may result in the failure of the vaccine to create the desired immune response and consequently provide poor protection, so even if vaccine is given to an individual the results would not be as promising as the company had suggested via trials, this problem has been observed not only in underdeveloped countries but developed countries too. Temperature of countries can also play a big role and if the country is underdeveloped and it doesn't have good transportation facility then such blunder is bound to happen, ,the only solution to this problem is to come up with a system which can detect a change in temp of vaccines and the surrounding and that's what we have come up with, our project title itself illustrate what our system does "Real Time Monitoring And Controlling Of Cold Storage Truck Using Iot"

II. LITERATURE SURVEY

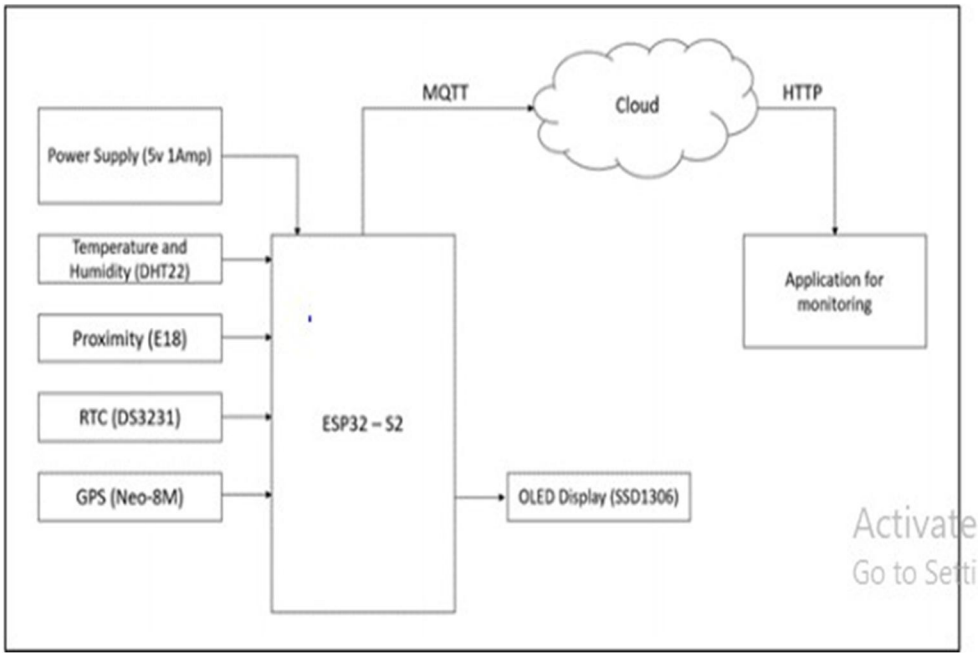
Unlike other common drugs, vaccines are unique drugs, which are very sensitive to temperature. When vaccines are exposed to temperatures outside the appropriate range, their potency diminishes (WHO, 2015). That is, the vaccines become useless. Therefore, in order to maintain their quality, vaccines should be continuously kept within their determined temperature range from production to use. The lack of proper storage and transportation temperatures for vaccines is one of the common factors limiting full and equitable immunization in many countries, this indicates that the failure to understand and properly address issues in the vaccine supply chain will greatly reduce vaccine's effects. (Brison & LeTallec, 2017). Some stingy companies in the vaccine industry will use non-cold chains to store or transport vaccines.

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For instance, in 2016, 25 kinds of vaccines were found to be illegally distributed to medical facilities in at least 24 provinces in China without approved temperature conditions since 2011, causing economic losses of more than 88 million dollars. Additionally, many developing countries do not have sufficient cold chain capacity (Ashok, Brison & LeTallec, 2017) and effective vaccine regulation policies and penalties. Moreover, unreliable electricity power systems and poor road conditions in many developing countries often result in cold chain breakdowns (Duijzer, Jaarsveld & Dekker, 2018; Lauton, Rothkopf & Pibernik, 2019). The WHO and UNICEF (the United Nations International Children's Emergency Fund) assessments in 65 low and lower-middle income developing countries revealed that few countries met minimum standards for effective vaccine storage, distribution, handling, and stock management (Lydon, Raubenheimer, Arnot-Krüger & Zaffran, 2015). Due to the temperature sensitivity of biopharmaceuticals, the cold chain has become an increasingly significant part of the overall pharmaceutical supply chain (Bishara, 2006). Hence, it is reasonable to deduce that the China's vaccine distribution scandal in 2016 is not an isolated case in developing countries. For instance, transportation of some kinds of vaccines requires refrigeration and freezing (Goldberg & Karhi, 2019). However, it was reported that 35.3% of shipments and 21.9% of refrigerators were found to be at temperatures below the WHO recommended freezing temperature range for vaccines (Matthias, Robertson, Garrison, Newland & Nelson, 2007). Murhekar et al. (2013) found that up to two-thirds of vaccines were damaged by freeze exposure in transit between state stores and administration sites across ten states in India and that exposure to subzero temperatures was frequent during vaccine storage at peripheral facilities and vaccine transportation. The cold storage chain is facing significant new challenges nowadays [1-3]. With monitoring and controlling temperature becoming essential along supply chains emerges as a key aspect to deal with vaccine waste , as well as increasing both vaccine safety and the quality offered to consumers. (Lopalco (2016) indicates that during the last decades, effective communication has become increasingly more important due to the progressive lack of public confidence towards vaccination. Evidence-based communication that is supported by reliable information on vaccine effectiveness and safety may be central for improving vaccine confidence and assuring mutual protection.

Whereas the early stages of processing and distribution compliance with the temperatures established for vaccine safety was reached , however, in the last three stages (considering here manufacturing , transport, retail,), temperature control and maintenance have become particularly complex [4,7,8]. In the retail sector in particular, the scarcity of data available on the fulfilment of cold chain control is highlighted [9,10]. Overall, scholars study the topics related to the vaccine supply chain, vaccine and product quality issues, and the implication of the cold chain. Their work provides ideas and methods that are helpful to our work. However, the existing research on vaccine quality issues and the vaccine cold chain is limited. In addition, there are many studies confirming that the temperature of display cabinets in refrigeration units is not always the appropriate one, according to safety standards.

III. PROPOSED ARCHITECTURE



Because of the refrigerator truck's wide transportation range and some which are still in areas with bad environment, which causes management difficulties in the process of transportation. The transport goods are vaccines with different requirement of temperature and which are not environment friendly and which are dependent on high requirement of environment. Combined with the characteristics of transportation process refrigerator trucks above, this system puts forward refrigerator trucks remote intelligent monitoring system based on the Internet of things. The system adopts modular and compact design which is constituted by multi-point temperature and humidity acquisition module, the door switch (proximity sensor), monitoring module in trucks , wireless network and so on. The system composition diagram was as shown in Figure 1. This system relies on advanced content networking technologies and combines existing modern technology to achieve real-time and accurate monitoring purposes. The temperature and humidity acquisition module constituted by high performance temperature and humidity sensor can be used to read the temperature and humidity conditions data within the refrigerator trucks real-time. To measure more accurate temperature and humidity data, more temperature and humidity acquisition modules can be placed in the box according to actual needs. The door switch is used to monitor the monitoring device switch state in the process of vaccine transportation to avoid vaccine loss. And the refrigerator truck's position is located and tracked by the GPS satellite and returns its positioning information with temperature and humidity data, door switch state to monitoring center through GPRS network Intelligent Monitoring System on Refrigerator Trucks Based on the Internet of Things. Using intelligent analysis software on the remote monitoring center terminal to display refrigerator trucks temperature and humidity data, door switch state and cargo information real-time to locate and track the location refrigerator trucks to implement intelligent monitoring management and make the whole system constitute a real-time, intelligent thing networking.

IV. CONCLUSION

The refrigerator trucks intelligent monitoring system which we have put forward by this proposed system is based on content networking technology and combined with cloud, sensor technology and wireless communication technology, etc. to realize purposes such as monitoring the transport process intelligently, improving transport efficiency, preventing the deterioration of vaccines in transit, and avoiding the loss of vaccines during transportation, and so on. The proposed system is very powerful to monitor refrigerated truck from anywhere and anytime using mobile application. This system is capable of controlling and monitoring through mobile application. We can achieve good results to data monitoring such as Temperature, humidity, and door status with MQTT. It is satisfied and well approved with the performance through the analysis of monitoring system and experiment testing results for the designed refrigerated

truck monitoring system model . Moreover, this proposed system has main advantages which is to minimize the human effort for the manual monitoring and loss due to uncontrolled and unpredictable environment. Though we can achieve all the goals of our project but still we think that lots of advancement and modifications can still be done on this project. We have provided the platform and anyone can access it. For advancements, we need more time, money, and hard work. Money would remain the critical issue to upgrade the project many of the components would need just an upgradation.

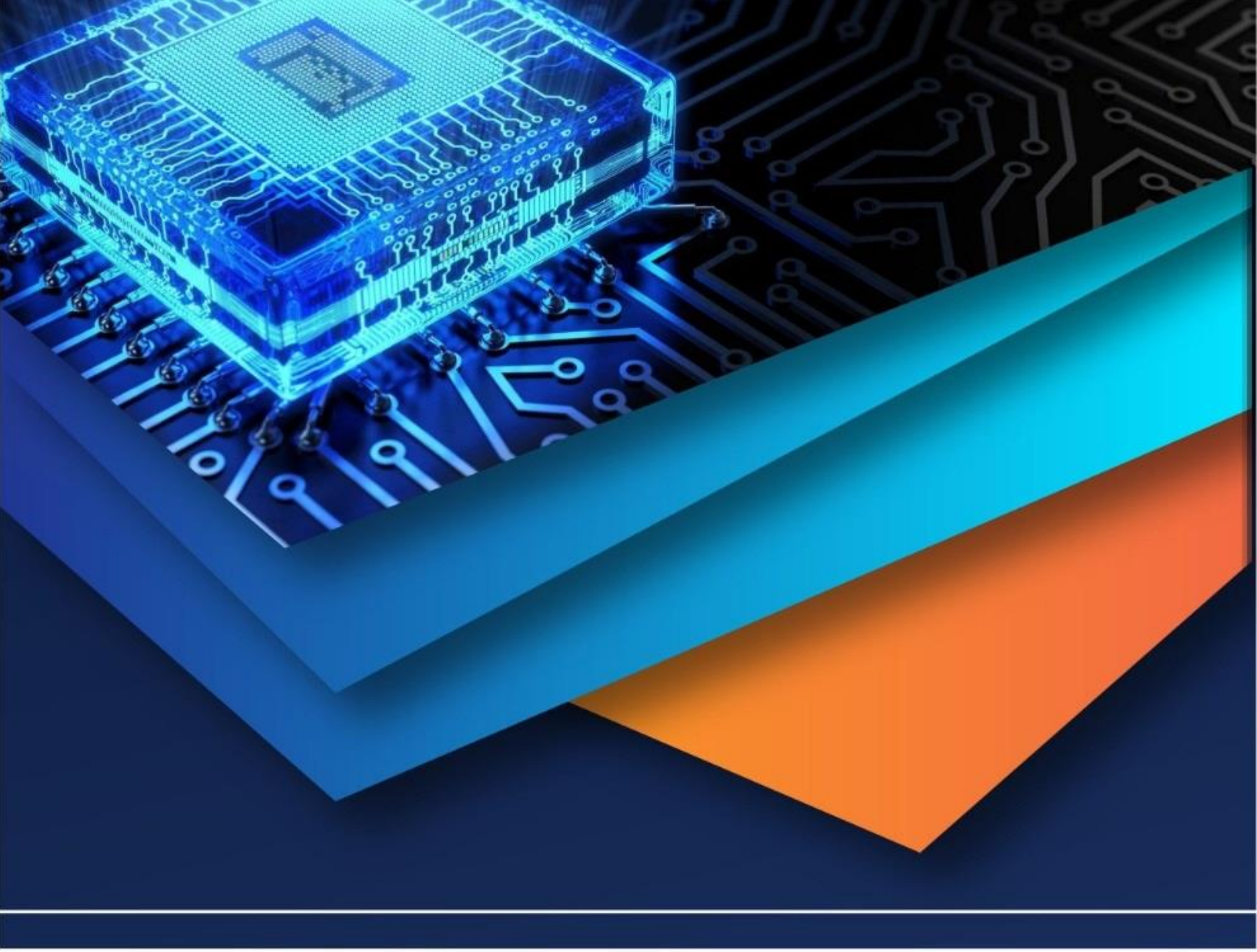
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