Abstract— Purpose of monitoring parameters like temperature and humidity can be done with help of techniques like RFID based or Wi-sensors based systems. Such systems are not suitable in environment that is dusty, dirty and polluted. Due to above lacunas the proposed system is introduced. Propagation abilities are affected due to antenna parameter interference. Propagation abilities affected due to presence of large quantity of water is surely eliminated. The temperature of shipment is recorded by thermochron DS1921G and humidity sensor DHT11 that implements 1-wire protocol authentication purposes are served by thermochron so as to provide security as well as multitasking temperature monitoring. This proposed system exhibits the use of 1-wire protocol for the monitoring of pharmaceutical products and frozen food during transit. Micro-controller of ARM7 family LPC 2148FBD64 will be used at the heart of the system. Tracing of shipment will be done using GPS technology and notifying user by GSM technologies. To design and implement a system for monitoring temperature and humidity and recording the latitude and longitude (location) at particular time during transit is the main purpose of this paper. The monitoring system will be stored inside the cool box.

Key words: 1-wire, thermochron, DHT11 ARM7, Transport, authentication, GPS, GSM

I. INTRODUCTION

Management of frozen foods and pharmaceutical products is one of the crucial necessities in cold chain companies. Hence, a system that would accommodate these necessities has to be developed. In the past many systems that employ Wi-sensors, RFID/USN to measure or control temperature and humidity have been designed. Every company specifies its own set of parameters that should be followed during transporting and management of the products. The condition of the products should be uniform or can say unaltered during transit. Usually, there is a huge possibility of alteration of the chemical composition of the food products or pharmaceutical products. Next problem could be counterfeited products [2] and the manufacturers blaming each other for the transport of altered products. A system that could provide maintenance of the appropriate temperature using an underlying protocol like the 1-wire system can be used. Due to its many advantages over the conventional I2C, SPI protocols the use of this protocol has been considered. Moreover, the use of only dual lines instead of four wire reduces interfacing complexity. Other advantages are the 1 wire devices are placed in stainless steel covers that are rugged and can be used in environments that are humid and full of moisture.

Similarly, for pharmaceutical product the system that can control the temperature so that the chemical composition of certain lifesaving drugs does not change in transit. The requirement of a system that is reliable in such kind of conditions and also the important factors nowadays is the speed and power consumption of particular system. Hence, instead of making adjustments/tradeoffs both the parameters are taken care of simultaneously.

A. Thermochron Sensor

Thermochron sensor is one of the members of the 1-button family of electronic identifiers. This digital thermometer measures temperature in a step of 0.5°C. The operational range is -30°C to +70°C. Accuracy of ±1°C can be achieved. A real time clock is present in the device. This device habitually wakes up and measures temperature at intervals that the user can program from 1 Minute to 255 Minute.data log memory is 2KB and general purpose is 512 bytes. It also maintains a long-term temperature histogram with 2.0°C resolution. Recording of up to 24 timestamps is performed. There are six different types of 1- buttons that are identification only (used for access control to various resources like building, equipment etc.), memory (non-volatile and programmable data storage), real time clock and secure (password protected memory). The proposed plan has the use of DS1921g temperature sensor that is also one of the uses. The DS1920G is a thermometer that reads the temperature of the environment or of the object to which it is attached. Touching a 1-Wire probe to the DS1921G tells the surrounding temperature, measured from a range of -55°C to +100°C.

B. 1-Wire Protocol Overview

As shown in fig 1 the master that is any microcontroller communicates digitally with the 1- wire slave devices over a twisted pair.

![Fig. 1: 1-wire implementation](image-url)

The 1-wire network consists of an open-drain master/slave network. This network is multidrop fashion. The 1-wire concept links the master initiating communication and the slave synchronizing with the master signals. The time logic of master and slave must measure and generate digital pulses of different lengths. There are four different modes through which a master initiates communication with the slave. Accessing an I-button through 1-wire port involves four steps[3] starting communication that is called reset or presence pulse, ROM function command, memory function command and finally transferring data.

Monitoring System for Frozen Food and Pharmaceutical Products during Transit using 1-Wire Protocol: Design and Implementation

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Abstract—Purpose of monitoring parameters like temperature and humidity can be done with help of techniques like RFID based or Wi-sensors based systems. Such systems are not suitable in an environment that is dusty, dirty and polluted. Due to above lacunas the proposed system is introduced. Propagation abilities are affected due to antenna parameter interference. Propagation abilities affected due to presence of large quantity of water is surely eliminated. The temperature of shipment is recorded by thermochron DS1921G and humidity sensor DHT11 that implements 1-wire protocol authentication purposes are served by thermochron so as to provide security as well as multitasking temperature monitoring. This proposed system exhibits the use of 1-wire protocol for the monitoring of pharmaceutical products and frozen food during transit. Micro-controller of ARM7 family LPC 2148FBD64 will be used at the heart of the system. Tracing of shipment will be done using GPS technology and notifying user by GSM technologies. To design and implement a system for monitoring temperature and humidity and recording the latitude and longitude (location) at particular time during transit is the main purpose of this paper. The monitoring system will be stored inside the cool box.

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Fig. 2: 1-wire signalling commands

The 1-wire bus is usually idleing high. The microcontroller initiates communication with the slave devices on the 1-wire bus, the master (microcontroller) pulls the 1-wire bus low as shown in Fig. 2 ‘M’ for 480us and maximum 640us. Next, the master leaves the 1-wire bus causing it to again go into the idleing high state. The bus remains in this state for a period of 15us to 60us to check if any slave is present and wants to transfer information. Then in case a slave is present on the line it shows its presence by pulling the line low for about 60us to 240us. During this time the other slaves are dropped off the line. This is called the ‘presence pulse’. After this recovery mode is achieved by the 1-wire bus going back into idle high state.

After the device shows its presence the ROM command sequence is executed as shown in Fig 3. There are several commands like ‘Read’ ROM, search ROM, skip ROM, match ROM and so on. The ROM that is unaltered is identified which is a factory programmed sequence that every slave device possess.

Fig. 5 shows the block diagram of DS1921 G. This diagram shows all the internal blocks of the thermochron like the oscillator part, memory, temperature recording and so forth.

Fig. 3: 1-wire signalling commands

Finally the R/W sequences are executed as shown in Fig. 4. Typically the 1-wire bus is idleing high. When the master wants to interact with the slave device it pulls the line low. The master will only start the communication and the slaves will remain in the vegetative state till it is not awakened up by the microcontroller. The master starts the WRITE1 series in which first the 1-wire line is pulled low for a TIME less than 15us and then releases the line. The slave device that is the thermochron will sample this line after 15us and will note that the line is high this in turn is recognised as WRITE1. Next, the WRITE0 sequence is similar to WRITE1 only that the 1-wire bus goes low after 15us. The master starts communication and pulls the line low for 15us T_{msr} and leaves it. This command is recognized by the master as READ1. For the READ0 command the master pulls the bus low for more than 15us T_{msr}.

Fig. 4: Timing Diagram
II. LITERATURE REVIEW

Eugen Diaconescu and Cristian Spirlean [3] have in the paper given basics of the 1-wire communication using both software and hardware applications.

Kai-Xin Tee, Moi-Tin Chew and Serge Demidenko [4] have demonstrated the use of I-buttons in warehouses where conventional storage has been replaced by the revolutionary I-button. Stock controlling and container tracking is done using 1-wire protocol. Complete 1-wire communication inside warehouse using micro LAN network has been done. The location of containers has been determined by using I-buttons. The same idea can be used in cool boxes where a different version of I-button that is having the ability to monitor temperature is used.

Chen-Ming Li, Chin-Chung Nien, Jia-liang liao and Yu-chee tseng [5], the system has been placed outside the cool box. It consists of wireless microcontroller JENNIC and thermocouple sensing convertor. The thermocouple MAX31855 is consuming a power of 5.4 mW. An aperture has been made and thermocouple has been guided into cool box. Frozen foods have majority of the part made of water hence the antenna gain parameters and propagation abilities are inflated. Likelihood of lesser power depletion in proposed system.

Mihai Hulea, George Mois, Silviu Folea, Liliu Miclea [6] introduce a monitoring system using RN-131C as the core micro controller and the sensor is a DHT22 working on 1-wire protocol. Comparison of this system shows that the micro controller works on 40 Mhz. and the detecting component is consuming a power of 4.8 m W.

III. DESCRIPTION OF SYSTEM

System implementation consists of interfacing following components together:

- ARM LPC 2148
- GPS MODULE(S1216)
- GSM MODULE(SIM300)
- THERMOCHRON (DS1921G)
- HUMIDITY SENSOR(DHT11)

1) Three modes are displayed as shown below. User can select mode of choice.
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IV. WORKING

A comprehensive list of all parameters is provided in the mode that is the switch 1. This switch when clicked displays continuous mode. Continuous monitoring of parametric will be done and displayed as shown in table 1 (continuous mode). Continuous mode will record all the data along with alarming conditions such that the alarming conditions will not be known and message received will be “current parameters are temp:x, hmdty:y, lat:z, log:w” and so on. Alarm mode activated when second switch is pressed. A predefined range will be specified such that any parameter going above that threshold will be notified through message “! Alert! Threshold Exceeded” will be displayed in alert mode if any parameter exceeds desired range. If at all requirement of complete list of alarm as well as continuous conditions together is needed, this will be achieved in the third switch. When third switch pressed the continuous+alarm mode activated. Table 1 shows a screenshot of the communications displayed on the handset. Flow chart shown complete step by step operation of the complete system stored with the consignment. The whole system is in the cool box. DHT11 used for humidity sensing. Power consumption can be reduced greatly as compared to other systems (table 2 ). Three separate approaches of procedure are provided i.e. continuous mode, alarm mode and a combination of both modes.

**Table 1: Display On Given Number**

<table>
<thead>
<tr>
<th>CONTINUOUS MODE</th>
<th>ALARM MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Screenshot" /></td>
<td><img src="image2.png" alt="Screenshot" /></td>
</tr>
<tr>
<td><strong>Current Parameters are</strong></td>
<td><strong>Alert! Threshold Exceeded:</strong></td>
</tr>
<tr>
<td>Temp:33°C</td>
<td>Temp:38°C</td>
</tr>
<tr>
<td>Hmdty:24%</td>
<td>Hmdty:35%</td>
</tr>
<tr>
<td>Log:25.00213</td>
<td>Log:23.9942</td>
</tr>
<tr>
<td>Date:29/05/15</td>
<td>Date:22/05/15</td>
</tr>
<tr>
<td><img src="image3.png" alt="Screenshot" /></td>
<td><img src="image4.png" alt="Screenshot" /></td>
</tr>
</tbody>
</table>

Without matching of 1-button for authentication the parameters like temperature, humidity and mobile number cannot be accessed.

Fig. 7: Three Modes

2) Continuous mode displays the following parameter as shown. These parameters are also sent to the concerned mobile number.

Fig. 8: Continuous mode

3) In the alarm mode a button on the internal circuitry is pressed. This particular button is for authentication purposes.

Fig. 9: Authentication

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V. RESULT

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Existing system</th>
<th>Proposed system</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| Processor      | 1. JENNIC5438 wireless microcontroller (paper 1) working at 32 MHz  
2. RN2411 operating at 40 MHz (paper 2) | ARM LPC 2418 working at 50 MHz        | ARM better at execution of instructions which results in faster processing of the parameters. |
| Power Consumption | 1. 5.4mA for the sensing element  
2. 4.8mA for the sensing element | 3.4W of the thermometer               | Lower power consumption resulting is better battery life for the proposed system |
| Reliability    | Affected by change in moisture and temperature variations, antenna parameters change with change in surroundings | Stainless steel package: highly tolerant towards Moisture and Temperature variations | Proposed system will have longer shelf life, with a high mean time in between failures. |

Table 2: Comparison of Previous Systems

VI. CONCLUSION

Being said that readers in RFID/USN based system can have problems when large numbers of tags are being read in the same field or when signals from two readers overlap in RFID tags. This is eliminated in multi drop fashion using 1-wire protocol. Similarly, technologies like wi-sensors the biggest disadvantages of large scale wireless sensor networks lies on the complexity of logistics involved, selective replacement of sensors that have ran out of energy. Several features of the 1-button like robustness, sturdiness, protection from clamminess, durability, survival in severe temperature overcomes the disadvantages that are prevalent earlier systems as described above. The drawback of this system is that there should be availability of open sky in order to get the GPS coordinates. The proposed 1-wire [8] based system used for temperature and humidity monitoring of cool box in cold chain logistics has been deployed. The system will be showing the latitude and longitude that will be specifying the location of the goods. Advantage is that this system consumes low power that can be used for effective monitoring of temperature and humidity. Other methods like wi-sensor networks, wireless sensor modules [6], RFID/USN based system [7] humiture sensors [11], and also being used for monitoring of temperature and humidity.

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