Thunder Detection and Damage Reduction System

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***Abstract*— Over the past ten years, highly sophisticated electronic equipment has permeated our homes thanks to significant advancements in electronic technology. However, this equipment is highly vulnerable to various interferences. Many technical drawbacks are optimized over the period of time. Some interferences still exist and they are considered as a major threat to electronic appliances. Thunderstorm is one of the interferences which can lead to damage or complete destruction of electrical equipment. This occurs due to lightning striking to a nearby electric pole which causes a surge of electricity that bursts through the power lines. Over $825 million was paid out on more than 100,000 damaged electronics claims each year due to lightning and surges. To mitigate this problem many researchers have proposed numerous methods that counteract this dire situation, but not all the solutions are cost-efficient and easy to use for general public. In this research, we proposed a cost-effective model where thunderstorms will be predicted, also based on that early anticipated data the home main switch will be automatically turned off and the thunderstorm's data will be sent to the cloud for further analysis. Also using a mobile app which is connected to the cloud server, data can be easily analyzed, make critical decisions and can control the home main switch.**

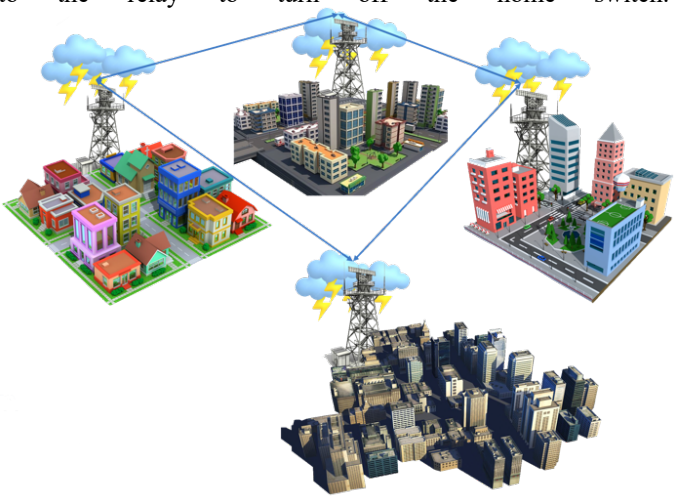
Keywords—IoT, Colonization, Damage Control, Thunder Detection

INTRODUCTION

IoT has already revolutionized every aspect of modern life. The smart home concept has already been implemented, and those building any new infrastructure, either residential or commercial, are using these facilities. Our idea is to take the use of IoT one step ahead to ensure optimum security and protect electronic appliances that are used at the home, office, and kitchen from electricity overload caused by thunderstorms. This paper is about our IoT design which has lightning sensors capable to detect cloud-to-ground or intra-cloud frictions. The friction between clouds is the primary cause of flashes that are the potential stimulus for lighting and thunderstorm. Depending on the lighting intensity, the sensor transmits the signal to the relay. If the signal is class 2 or class 3 the relay will switch off the main electricity connection so that the electronic devices present within the facility remain safe. Hence, we can minimize losses due to natural disasters. Simultaneously, the thunderstorm data will be recorded and stored in the cloud server. Routinely these records can be accessed through a web server or mobile phone application for further analysis. Additionally, the relay is controllable remotely through the mobile app, therefore, it can be turned on when potential threats such as rain & storm are over. This work enables convenience along with the safe and efficient use of electronic appliances. Implementation of this project in a country prone to natural disasters like Bangladesh can be a smart solution to financial losses due to thunderstorms.

METHOLOGY

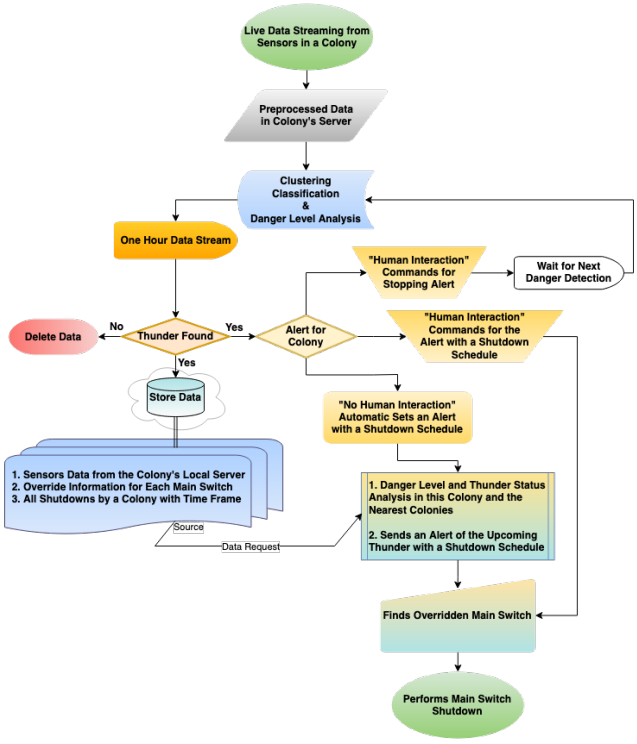
A conceptual framework of the model has been proposed in Fig 1., the entire workflow of the system is illustrated in this section. Initially, AS3539 lighting sensor will anticipate the thunderstorm in early phases by sensing electromagnetic radiation. The rapidly changing currents of the strike cause electromagnetic pulses (pulse time 10-150ms) in the VLF (3k-30kHz) and ELF (<3kHz) radio bands. The maximum amplitude lies around 5-10KHz. When the lightning is likely to *strike,* an alert is sent to a Relay, which will immediately turn off the home main switch. A relay module is basically an electrical switch that is operated by an electromagnet which is activated by a separate low-power signal from a micro controller. The electromagnet pulls to either open or close an electrical circuit when it is activated. *So,* the developing board is actually sending a signal to the relay to turn off the home switch.



After that, all the thunderstorm data will be transferred to the cloud for further analysis.

After that, all the thunderstorm data will be transferred to the cloud for further analysis. To establish a communication channel the model incorporates a GSM module SIM800L which allows for GPRS transmission, sending/receiving SMS and making/receiving voice calls. Using this modem, all the collected sensor data will be transferred to the cloud for storing and further analysis. ThingSpeak cloud platform is used for this section because it is an IoT analytics platform service that allows to aggregate, visualize, and analyze live data streams in the cloud. Data can be sent to ThingSpeak from a device, create instant visualizations of live data, and send alerts. When all the sensor data is received by ThingSpeak, it will do further analysis and make a report on it. This cloud platform offers a UI in form of mobile application and web service so that users can easily visualize the data and make decisions. In addition, a user can also control their home main switch using the ThingSpeak platform by sending a message to the relay to turn on the switch. ThingSpeak will send a message through SIM800L and after receiving the message to the Arduino board, it will send a voltage to the relay to turn on the main switch.

FLOWCHART



The Internet of Things (IoT) is an advanced Internet-based technology which has invaded most fields of science and technology today. IoT enabled digital devices, online-services, medical equipment, and smart-home development in market. In this web-based technology, smart things such as electronic devices, wireless sensors are connected to cloud network to carry out different functions. Due to IoT application, data collection- exchange- transfer- storage has become easy and time saving task. IoT has been implemented in many electrical appliances. Home Automation, Smart Cities, Automatic irrigation Systems, Healthcare and many more are the key areas where IoT has provided automation and help humanity to reduce their manual work.

Various home switch controller systems were proposed in literature with different specifications and functionality. IoT has done tremendous achievement and everything is going to be more smart and intelligent in next few years so ordinary home system will also move to the platform of IoT. The intelligent home automation system with low cost is presented by implementing Arduino UNO microcontroller. There are two main modules that are software communication module and hardware interface module.

Thing speak is used for collecting data with advanced data analysis through MATLAB. It works with various software's like MATLAB, LoRa WAN, Things Network and is compatible with boards like ESP8266 Wi-Fi module, Rasp-berry Pi, CC3200 etc.

AS3935	Distance (KM)	Wind Speed (KM/h)	Humidity (%)	Temperature (C)	Light Flash (1,0)	Thunder Sound (1,0)
11111	31	0.644	0.73	16.18333333	0	0
11011	27	9.0965	0.84	13.83888889	0	0
11000	24	9.2092	0.93	13.77222222	0	0
10100	20	9.9015	0.82	13.28333333	0	0
10001	17	10.4006	0.95	12.75555556	0	0
1110	14	11.2056	0.89	12.16666667	0	0
1100	12	11.3344	0.83	11.25	1	1
1010	10	12.0106	0.93	11.18333333	0	1
1000	8	13.8299	0.79	11.11111111	0	0
110	6	14.3612	0.63	11.11111111	0	0
101	5	17.0982	0.6	10.69444444	1	0
1	Storm	22.0409	0.87	8.633333333	1	0

A thunderstorm refers to a deep moist convection event and is accompanied by lightning, thunder, rainstorms, hail, gale, turbulence etc. It is an important component of disastrous weather in China. Thunderstorms threaten aviation safety and affect aviation operations. According to the statistics of civil aviation organizations, the accidents directly and indirectly caused by thunder-storms account for more than 50% of all the flight accidents caused by meteorological reasons. Improving the ability to identify thunderstorms is of great significance for forecasting and early warning and further reducing risks and losses. Thunderstorms are characterized by short life cycle, small range, and strong destructive power.

Colony Name	Main Switch IP	Used Port List	Overridden Ports	House Address
Colony A	172.16.0.1	8801, 8802, 8808	8808	8th Floor, Ho. 88, Rd. 8
Colony A	172.16.4.4	8401, 8404, 8484	8404, 8484	4th Floor, Ho. 88, Rd. 8
Colony B	172.21.2.1	8202, 8433, 8424	N/A	2th Floor, Ho. 88, Rd. 8
Colony B	172.18.8.4	8123, 8321	N/A	6th Floor, Ho. 88, Rd. 8
Colony C	172.25.5.2	8989, 8899, 8889	8889	3th Floor, Ho. 88, Rd. 8

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"Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is . . ."

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The subscript for the permeability of vacuum μ_0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o".

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Table Head	Table Column Head		
	Table column subhead	***Subhead***	***Subhead***
copy	More table copy[a]		

Sample of a Table footnote. (*Table footnote*)

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Example of a figure caption. (*figure caption*)

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G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*

J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.

K. Elissa, "Title of paper if known," unpublished.

R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.