

Design of an Internet of Things Rain Detector Device with GSM Notification.

GRACE CHINYERE KENNEDY¹, B. J. LUCKYN², JAJA, TAMUNOTONYE TAMMY³,
IDAHTONYE TOBI⁴

¹ Department of Computer and Science Engineering, Kyungdong University, Korea

^{2,3,4} Department of Electronics/Computer Engineering, Rivers State University

Abstract- *One of the most significant factors affecting the quality of life and activity of the growing population is the climate change. Sun drying, a practice that has been used by man for countless items since the dawn of time, is done for a variety of reasons. These include eliminating all water molecules completely from the items being dried, such as clothing, some farm produce, during construction work, in industries where certain plants used for pharmaceutical or chemical purposes are briefly exposed to direct sunlight to induce some chemical changes in them, and at home when windows are opened to let sunlight enter rooms to remove moisture and allow for proper aeration. The above-mentioned benefits of sun drying are often hindered by rain, especially if the materials being dried in the sun are not retrieved right away. As a result, creating and designing an Internet of Things rain detector device with GSM notification sends a text message to alert the user. As soon as it begins to rain, a GSM notification serves as a signal to alert the user when it is about to start raining by detecting raindrops. The Arduino board in this project system senses the environment by taking input, and it can have an impact on its surroundings by controlling the GSM module. The rain sensor module is used to measure the amount of precipitation. The Arduino is connected to the rain sensor module. To a given mobile number, the real-time results are sent via text message. For text messaging, an Arduino board is connected to a GSM modem.*

Indexed Terms- *IoT, GSM, Rain Detector, Arduino devices*

I. INTRODUCTION

After the advent of information technology, there has been a revolution in both people's daily lives and workplace conditions. Due to its numerous applications, this idea is growing in popularity across many horizontal and vertical markets, including everyday life in society. Large corporations, who stand to gain greatly from the foresight and predictability provided by being able to track every object through the supply chains in which they are embedded, have primarily driven the development of the Internet of Things (IoT). Through IoT, the ability to code and track objects has helped businesses become more productive, streamline procedures, lower error rates, stop theft, and implement intricate organizational structures. The Internet of Things (IoT) is a technological revolution that represents the future of computing and communications. The growth of the IoT depends on rapid technological advancement in a number of key areas, including nanotechnology and wireless sensors. They will tag every object in order to identify, automate, monitor, and control it.

An Internet of Things (IoT) device is a piece of equipment with a sensor on it that can use the internet to transmit data from one object to another or to people. Wireless sensors, software, actuators, and computer hardware are examples of IoT devices. In order to give us control over the things around us and to keep us updated on their status, the Internet of Things aims to bring everything in our world under one common infrastructure.

Nature's elements have always been used by mankind for a variety of purposes. Water is used for irrigation and electricity production (Fthenakis and Kim, 2010), wind is used to power wind mills, which are used for a variety of tasks like crushing stone in quarries and

drying, heating, and electricity production in the sun (Mekhilef, Saidur and Safari, 2015). Sun drying is the process by which people from time to time use the sun to dry things. For a variety of reasons, sun drying is done in farms, homes, businesses, laboratories, hospitals, and other establishments (Amos, 2014). All the benefits of sun drying are hindered by rain, especially if the materials being dried are not quickly retrieved (Bagree, 2012). In order to give one time to gather the materials that have been sun-dried, a device that alerts the user the moment it starts to rain was designed and built. Additionally, since it can rain at any time without prior notice, clothes that are almost dry on a clothing line outside the house risk becoming wet once more if they are not retrieved in time. As a result, this project will also assist housewives and other users in being quickly alerted to prevent rain from wetting shirts and dresses that are being dried outside on a clothes line (Barnaghi et. al., 2012).

Additionally, developing a tool that alerts users when it is about to rain also helps farmers avoid wasting water by telling them to quickly turn off their irrigation system. An electronic device known as a rain detector can identify the presence of a specific amount of precipitation. It can be used in close proximity to high efficiency finance pumps, sump pumps, washing machines, bathtubs, toilets, and dishwashers. One of the main goals of this innovative project is to implement dependable and efficient methods of relatively simple design and construction that will immediately send a GSM notification to a specific line after a set period of time. It also relates to a rain detector with a GSM module, whenever it detects rainfall or water using a rain sensor and a GSM module. When it detects rain, a rain detector automatically turns off a lawn irrigation system. It is a moderately cost-effective device that can reduce water usage by up to 45%, contribute to environmental protection, and save water. To collect rainwater unhindered, a rain sensor is mounted outdoors, away from trees and roof overhangs. A lawn irrigation system can have a wired or wireless rain sensor attached to it.

In essence, a GSM module is a GSM modem created for Short Messaging Service wireless radiation monitoring (SMS). The most widely used international standard for mobile telephony is called Group Special

Mobile (GSM). According to the GSM Association, the standard is used by 80% of the world's mobile market. More than 1.5 billion people use GSM in more than 212 nations and territories. Text messaging, also known as short message service (SMS), was first implemented at low cost using GSM. A feature that is part of the standard is a global emergency phone number. A GSM modem is a particular kind of modem that utilizes a SIM card and a mobile operator subscription. It is simple to create applications for SMS control, data transfer, remote control, and logging. Some of the applications include security applications, sensor monitoring, SMS-based remote control and alerts, and GPRS mode remote data logging. This module can send text SMS messages to a host server after receiving serial data from radiation monitoring devices. It is connected to a printed circuit board, and the board provides various outputs to the device. For direct computer interfacing with Arduino and other microcontrollers, use TTL (Time to Live) output.

II. PROBLEM STATEMENT

Most of the fresh water on Earth is deposited by rain, which is an important part of the water cycle. It provides water for hydroelectric power plants and crop irrigation, as well as favorable conditions for a variety of ecosystems. Additionally, there may be drawbacks such as wet clothes left out on the dryer, overwatered plants that lose soil nutrients, broken internal home furnishings brought on by windows left open for ventilation, etc. Designed for the above listed problems to be avoided, a rain detector device with GSM notification will come into utilization for occupants in an environment having the occurrence of frequent rainfall so as for a notification to be sent to their phones to alert them.

Additionally, some electrical devices and plumbing fixtures may slowly leak but go unnoticed. An excessive amount of moisture from a slow leak can seriously harm a home's walls and floors. Mold development is also a possibility. To alert residents to leaks so that the appropriate steps and procedures will be taken to fix the issue, a rain detector device can be used.

• OBJECTIVES OF THE STUDY

The Objectives of the project are as enumerated further down.

- i. To have better understanding of the working principles of a constructed IoT rain detector device using GSM notification.
- ii. Design of the block diagram and circuit diagram with the necessary components.
- iii. Implementation and testing of the designed project.
- iv. Evaluation of the result.

• RELATED WORKS

Electrical and electronic engineers have created a variety of mechanisms for the detection of rainwater since a few years ago. These projects cover a variety of topics, such as rainwater harvesting, the use of rain detector circuits and devices in irrigation, and automatic rain sensing windows, which use rain detectors and sensors in cars to automatically operate the power windows and roof whenever it detects moisture. In his work, Oyubu (2017) explained how automatic rain sensing windows were used to develop a device that would enable car windows to automatically roll up when it rained, protecting the interior from harm. The design was primarily applied to cars. Campbell, 2000 built a scientific rain detector whose output was used to turn on or off another circuit. The rain detector senses whether it is raining or snowing. Mohammed (2012) incorporated a rain detector into his work that was made to automatically collect rainwater and store it in a reservoir for domestic use.

In 2016, Prabhakar H. et al. created a device. There are trays in their project that open and close in response to sunlight. The tray is fixed to a roof and operated by an 8-bit microcontroller that can detect this weather condition. The goal of the device developed by (Imran & Gupta, 2015) is to create a system that will enable car windows to automatically roll up when it rains, to prevent interior damages, and to make the device user-friendly. The goal is to create a dependable rain detection system that can be purchased by a sizable market of car owners.

Eneasoba and others (2020) With the help of modern technology, such as the Internet of Things (IoT), users can quickly and efficiently control hardware devices

over a large area using minimal power. Home appliances, businesses, industrial machinery, and other devices all depend on this energy. It's crucial to efficiently manage the energy used by household appliances. In this project, home appliances are regulated online. The plan evolved into a system that could manage multiple electrical loads connected to various terminals. As soon as the connection was made, a user interface was created to interact with the system, enabling users to easily control these home appliances online. When the system is routed through an IP address, remote users can easily access home appliances. Thus, in Internet of Things (IoT) devices and designs based on the technology in question, the time delay inherent in Home Automation systems technologies that include Bluetooth, Zigbee, and Z-wave uses remote control either through sending (SMS) is eliminated. However, the user can easily control the appliances, which reduces the consumption of energy in a proportional way.

For automated farm irrigation, Raju (2017) used the Arduino microcontroller, temperature sensor, and rain sensor module. In order to keep crops from spoiling during rain and effectively recycle rainwater for irrigation, Ruby and Jawahar (2017) worked on smart agriculture. They used the Arduino microcontroller, the Wi-Fi module, the rain sensors, the GSM module, and other components. Using Arduino, Latha and Murthy (2016) developed a GSM-based rainfall detector. In their research, a rain sensor module with an LM393 interface was used to measure rainfall. The measured values were then sent via text message to a predetermined mobile number for analysis. A self-contained electronic device called a water/rain alarm detector sounds an alarm when its sensor comes into contact with water. It includes a microcontroller and a rain sensor (Jayant, 2015). (Hernando, 2016). It can be used close to high-efficiency furnace pumps, washing machines, toilets, dishwashers, and water pumps (Beard et al., 2010). They could be employed to notify users when there is a moisture issue (Becker & Gudesen, 2000).

• INTERNET OF THINGS

The two words "Internet" and "Things" were combined to form the phrase "Internet of Things," which is also commonly abbreviated as "IoT." In order to serve billions of users globally, the Internet is a

system of interconnected computer networks that operates globally. Millions of private, public, academic, business, and government networks, ranging in size from local to global, are connected by a wide range of electronic, wireless, and optical networking technologies to form this network of networks. More than 100 nations are currently connected to the Internet for the exchange of information, news, and ideas. One of the main issues with the IoT is that it is such a broad and expansive concept that no uniform architecture has been proposed. The Internet of Things (IoT) concept requires a variety of sensor, network, communications, and computing technologies, among other things, in order to function.

The fundamental idea behind the Internet of Things (IoT) is to enable autonomous information exchange between various, individually identifiable real-world devices that are invisibly embedded all around us. This is made possible by cutting-edge technologies like RFID and Wireless Sensor Networks (WSNs), which are sensed by sensor devices and then processed for decision-making, on the basis of which an automated action is performed. Ning and Hu present a vision for the worldwide rapid development of IoT in their paper, "Technology classification, industry, and education for Future Internet of Things." They suggest two IoT models for the future. The complex IoT technologies are categorized using a dimension model, and the architecture of a future IoT system is built using a layer model. The Internet of Things (IoT) is a technological revolution that represents the future of computing and communications. The growth of the IoT depends on rapid technological advancement in a number of key areas, including nanotechnology and wireless sensors.

• RAIN SENSOR MODULE

A rain sensor can be connected to an Arduino to create a rain detection device. Using a rain sensor, rain water is detected, and after a predetermined amount of time, the rain sensor alarms and texts the designated person. This is a low-cost, straightforward Arduino experiment. A switching device that is activated by rainfall is known as a rain sensor or rain switch. For rain sensors, there are two main uses. The first is a water-saving device attached to an automatic irrigation system that causes it to turn off during a downpour. The second is a device that shields an

automobile's interior from the elements and supports the automatic windscreen wiper mode.

III. MATERIALS AND METHODS

REQUIRED COMPONENTS USED

- i. Arduino board (Uno)
- ii. GSM Module
- iii. Rain Sensor module
- iv. Lithium-ion battery
- v. Vero board

DIAGRAMS OF THE CONSTRUCTION

BLOCK DIAGRAM

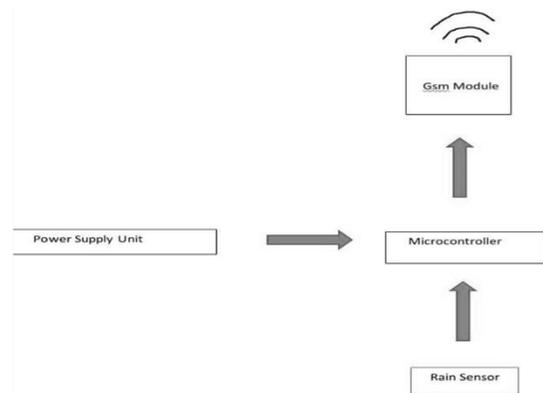


Plate 1: Internet of Things Rain Detector Device with GSM Notification Block Diagram

CIRCUIT DIAGRAM

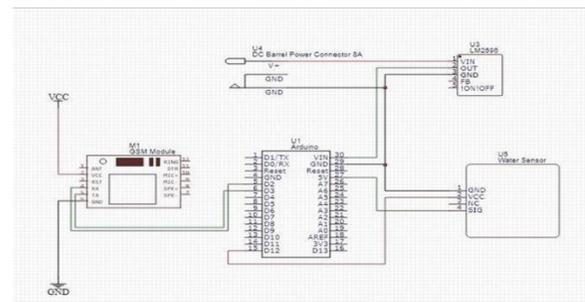


Plate 2 Circuit diagram

METHOD OF CONSTRUCTION

1. Assemble the circuit on a good quality breadboard.
2. For assembling the rain sensor, build one or buy.
3. Hook the rain sensor up to the Arduino.
4. Provide the sensor with power. Connect the Arduino's 5V pin to the VCC pin on the module.

5. Connect the VCC pin to a digital pin of an Arduino and set it to HIGH or LOW as per requirement.
6. Also, the total power drawn by the module (with both LEDs lit) is about 8 mA, so it is okay to power the module off a digital pin on an Arduino.
7. Connect the VCC pin on the module to the digital pin #7 of an Arduino and GND pin to ground.
8. Finally, connect the DO pin on the module to the digital pin #8 on your Arduino



Plate 3: Circuit design on Veroboard

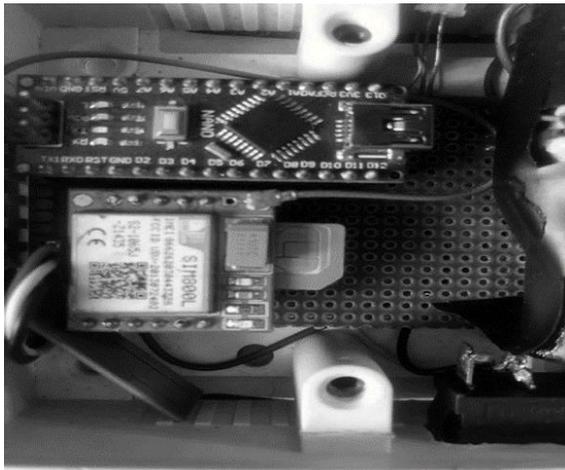


Plate 4: Circuit showing GSM module and SIM card

IV. RESULTS

When the system is turned on, it automatically tries to create a connection with a network provider. It constantly checks the rain sensor for water, if water is detected it sends an SMS to a preregistered number, then waits for one minute before checking again.



Plate 5: Test Result

According to the analysis above, there is a delay of about 1.5 to 2 minutes for each set of data from a different operator, though this delay appears to be less significant. One of the causes of this delay is this GSM-based technology's network dependence on the GSM service provider. This is due to the possibility that the user is in an area with poor network coverage. According to research, MTN to MTN communication appears to have the least amount of delay (49 seconds). In light of this finding, the MTN network service provider was employed in the project's sending and receiving terminals, i.e., communication via SMS is conducted between two MTN service providers, one in the user terminal (a GSM system) and the other in the system.

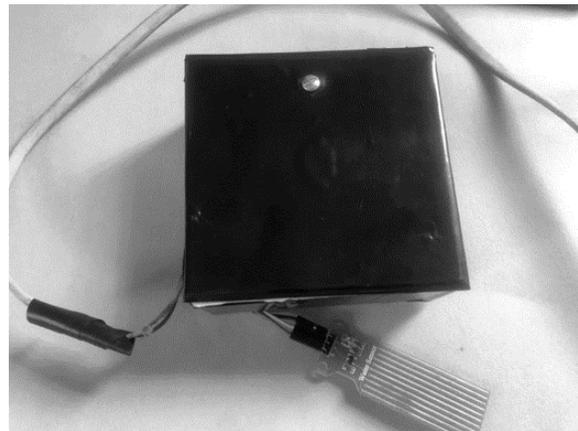


Plate 6: Complete project arrangement



Plate 7: LED display

When water is detected on the rain sensor, the LED displays a green coloured light, indicating the progress report.

CONCLUSION

This work is the design of an IOT rain detector device with GSM notification that can detect rain fall and automatically send a notification to a GSM device. The device was able to detect any moisture or drop of liquid on the rain sensor panel or board using an embedded system for the detection of rain and its program into the microcontroller. It is determined that the aim and objectives of the work have been attained. A system which was designed to solve the problem of loss of valuable items. The results of the tests show as satisfactory, the reliability of the various units and the system as a whole and at the end of the design of the work.

REFERENCES

- [1] Emeasoba, U. Princewill,; Luckyn, J. Boma (2020) Home Appliances Energy Consumption Control Using Internet of Things (IoT). JECET (9)3, 261-270 (DOI: 10.24214/jecet.B.9.3.26170)
- [2] Barnaghi P, Wang W, Henson C & Taylor K (2012). Semantics for the internet of things. Int. J. Semantic Web and Information System.
- [3] Botterman M. (2009). Internet of things: An early of the Future Internet. Report of the Internet of Things Workshop.

- [4] Carretero J., & Garcia J. D., (2013). The Internet of Things: Connecting the world. Personal Ubiquitous Computing.
- [5] Evans, B. (2011). Beginning Arduino Programming.
- [6] Fthenakis V., & Kim H.C., (2010). Life-cycle uses of water in US electricity generation
- [7] Gershenfeld, N.; Krikorian, R.; Cohen, D. (2004). "The Internet of Things ". In: Scientific American.
- [8] Gigli, M. and Koo, S., (2011). Internet of Things, Services and Applications Categorization. Advances in Internet of Things.
- [9] Hernando B., (2016). The Untold History of Arduino. Arduino History; Retrieved 2019 from <https://arduinohistory.github.io/Luettu>
- [10] Jayant, (2015). Rain Alarm. Circuit Digest.
- [11] Ko B., Kwak S., (2012). Survey of computer vision-based natural disaster warning systems.
- [12] Latha, N. A. & Murthy, B. R., (2016). GSM based rain fall detector using Arduino. International Journal of Electronics and Communication Engineering (IJECE)
- [13] Pentland, A.; Dutta, S.; Mia, I. (2009). "The Global Information Technology Report 2008-2009".
- [14] Weiser, M. (1991). "The computer for the 21st Century", Science. America.