INTI JOURNAL | eISSN:2600-7320
Vol.2019:33

Study and Implementation of Internet of Things (IoT) Based on Rainwater Sensor Using Arduino through Mobile Application

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Abstract

Rain is very important to our ecosystem and has many benefits such as generating energy through hydropower. Internet of Technology draw much attention with various monitoring capabilities into current building such as houses. Arduino is a device to interface between a microcontroller and sensors. The combination of Arduino, rainwater sensor and mobile application in this system can help to alert people when it is raining. The system ensure the LED and buzzer is activated when it's raining and to enable user to connect their mobile application with the rainwater sensor system and control it by just clicking on the buttons available in the mobile application. Upon receiving the signals from this system, user should be aware of rain and take the necessary steps to collect the rainwater.

Keywords

Internet of things (IoT), Rainwater sensor, sensor, rain detector

Introduction

Water is a precious resource in our environment. Growing populations, urban and suburban sprawl and ongoing droughts are impacting our water resources, resulting in natural habitat degradation and impacting the amount of water that is available for everyday use (Bangalore, V. L. (2011). Several research was done to detect to respond to rain fall to protect (Wohlfahrt, K. H., & Ebner, T., 2011) or make use of this water (Hosoya, M., 2003; Zaizen, M. et al., 2000). Rainwater sensor system is mainly used to detect the changes in weather due to rain fall. For example, this rain sensor can be implemented in cars, so that when it's raining the wipers are activated automatically (Wohlfahrt, K. H., & Ebner, T., 2011). Similarly, it can also be integrated at homes where buzzers are activated to indicate raining and in complex connection, it can be linked together with the lighting system of the house. So, when it's raining, the lights are on automatically. Most importantly, the rainwater sensor can be controlled by a simple mobile applications that allows users to perform simple task from time-to-time. For example, having a buzzer connected to the system helps a sleeping person in the house to wake up and collect the drying clothes.

Arduino is an open-source electronics platform use to communicate between hardware and software. Arduino is able to read inputs and turn it into an output such as activating a motor, turning on an LED or sending a message online (Lee, S. et al., 2014; Doukas, C., 2012).

International Conference on Innovation and Technopreneurship 2019
Submission: 1 June 2019; Acceptance: 20 June 2019

Building a simple system where everything is programmed on this microcontroller called Arduino creates a monitoring system.

The Internet of Things (IoT) is an approach where to interrelate computing devices, unique identifiers (UIDs) and transfer the data over a network. Recently, wireless sensor networks draw much attention as the sensor nodes equipped with various monitoring capabilities (Xia, F. et al. 2012; Yun, M. & Yuxin, B., 2010; Gubbi, J. et al., 2013) such as houses. In this proposed system the integration of Arduino, rainwater sensor and mobile application is able to help alert people when it is raining and take the necessary steps. The main objectives of the system is as stated below:

I. To indicate user if there is rain
II. To ensure the LED and buzzer is activated when it's raining
III. To enable user to connect their mobile application with the rainwater sensor system and control over it

Methodology

To study further on the proposed system, both quantitative and qualitative were carried out. Quantitative method using questionnaire where a form of feedback were gathered from various user of a particular field of interest. This questionnaire is a feedback from a group of people which was further used to analyse the results. Secondly, qualitative method using interview was conducted by face-to-face communication to collect the data and information. The main purpose of the methodology is to collect data from general public and to have deep understanding on what people think about rainwater sensor. Moreover, the data collected can be analysed further in order to improvise the system.

To develop the system, Arduino UNO, Arduino IDE (Integrated Development Environment), rain sensor module, LED, jumper wires and MIT App Inventor are employed. Figure 1 shows the Arduino UNO board is an open-source microcontroller board to develop a system and Arduino IDE is used to program the board accordingly. Figure 2 shows the Arduino integrated development environment implements Java programming language to support Windows, macOS as well as Linux since as cross-platform. Programs that are uploaded to the Arduino board can be written using this IDE. The source code of IDE is released by GNU General Public License. Other than Java language, Arduino also supports languages such as C and C++ but with certain code rules and structures.

Figure 1: Arduino Uno

Figure 2: Arduino IDE

A rain sense module which is used for rain detection is shown as per Figure 3. Therefore, this is the main component to detect rainwater and send data to the Arduino board

and the code are executed in order to print the rain sense reading in the serial monitor. This module is mainly used to measure rainfall intensity. Figure 4 shows the light-emitting diode (LED), which is a semiconductor light source that emits light when current flows through it. Figure 5 shows the buzzer which is an audio signalling device. The typical uses of buzzers is to alert users about certain situations where the buzzers acts as an alarm device. For example, if there is a thief trying to break in your house then your house alarm system will trigger to indicate that there is something wrong in your house.

Figure 3: Rain sense module

Figure 4: LED

Figure 5: Buzzer

Jumper wires as shown in Figure 6 is an electrical wire with a connector or pin at each end, which is normally used to interconnect the components of a breadboard horizontally or vertically without the need of soldering. There are many types of jumper wires like male-to-male, female-to-female and male-to-female. Finally, Figure 7 shows the MIT App Inventor for Android which is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology, which allows newcomers to computer programming to create software applications for the Android operating system.

Figure 6: Jumper wires

Figure 7: MIT App Inventor

Results and Discussion

Based on the quantitative and qualitative methods carried out, it was surprising that quite a number of the respondents were not aware of IoT and Arduino platform as they might have not been exposed towards it. In short, they are not a multidisciplinary group of people where they only focus on field and career that evolves between them. For example, the people in business background they are likely to look into business transformation, process, requirements and needs rather than information technology field. They might even think twice to implement any new technologies and trends of information technologies in their business environment as it is costly. Besides that, most of respondent around 75% to 80% agreed that they will try the system and recommend it to others. This shows that if people have deep knowledge on this system then they are likely to use it for their own purposes. This simple system might not be very

helpful in agriculture and automobile field as it need to be developed further with many more components but people can use it for themselves where they can explore and integrate the system based on what they want. However, during the interview session, it is discovered that people are only interested in buying the system only if they get to know more about the features and functions of the system. Respondent said that they want to try the system in hand and experience it first before recommending it to others. Surprisingly, some said that they did not prefer to buy the system as its benefit is limited to certain field and expressed their concern on the way they will use it. Finally, many of them wanted a wireless system as they can move around freely just by controlling the rainwater sensor from time-to-time.

For the implementation, the system is able to detect the amount of rainwater on the rain sense module and successfully sends the data to both the serial monitor and mobile application which the user has to download. Once the mobile Bluetooth is on and connection is made between mobile to HC-06 which is the Arduino Bluetooth module. Sensor value will be displayed on mobile application. Users must ensure to on the system just by clicking on the "ON System" button in the mobile application. Besides that, if there is sufficient amount of rainwater in the rain sensor module, then the LED and buzzer is activated. In this case, "Heavy Rain" appears on both the serial monitor and user's mobile application to indicate user that it is raining heavily outside. At this stage, the user can click on "OFF Buzzer" button to disconnected the buzzer activation.

The amount of rain water that pours are also detected in this system as detailed below:

I. If the rainwater reading is above 500 and below 800, then only the LED is set to be activated. In in this case, "Raining & Light turned on" appears.
II. If the rain sense reading above 800, and if it is equivalent to 1023 then the system actually doesn't do anything which basically means the system is in sleep state. So, "System is in sleep mode" appears both on serial monitor and mobile application.
III. Meanwhile, "Drizzling & System is in sleep mode" appears on the screen if the rain sense reading is above 800 and below 1023.

Moreover, if the user clicks on any button in their mobile application, then they will be indicated respectively. For example, if the user clicks on "OFF LED" button, then they will indicated with the "Light turned off". Finally, even when it is not raining outside, the user can choose to on LED just by clicking on "ON LED" button in their mobile application and then off it whenever they want again by clicking on the respective button given. Figure 8 shows the hardware design of Rainwater Sensor while Figure 9 shows the mobile application for rainwater sensor.

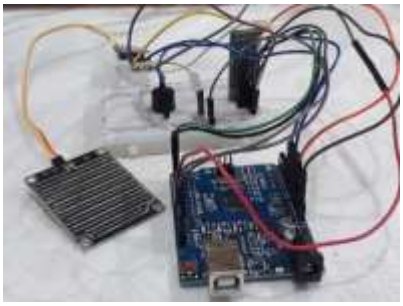

Figure 8

Figure 9

The system entirely integrates Arduino, rainwater sensor and mobile application to help alert people when it is raining and take the necessary steps. A more user-friendly mobile app can be built. Besides that, the system is fully functional and the outcome of the project is a highly beneficial. The mobile app interface for the improvise system can be further developed as the current has many buttons placed on the main screen. Besides that, the sensor value is placed at the bottom of the page and the user can scroll down to view the previous sensor value. Furthermore, the rainwater sensor can work with water level, humidity, temperature, and soil moisture sensor in the future. Therefore, a system that can support multiple situation and environment could be built if many sensors are integrated to it. For example, rainwater sensor helps in agriculture field where irrigation system can automatically stop the irrigation when it is raining. If the soil moisture sensor is integrated together with the rainwater sensor then the farmer can also learn about the moist level of the soil. Last but not least, a simple rainwater harvesting system can be developed. The system can be further developed in a way to indicate it's raining and to collect the rainwater. This can be done easily by using the system that the authors have developed. For example, if it is raining heavily, then system can alert the user and automatically open the water catchment area or specific water tank to collect the rainwater. In this way, the user gets more benefit since the collection of rainwater is done automatically instead of the user collecting it manually.

Conclusions

In conclusion, the proposed system is designed to serve the public in reserving rain water. This system integrates Arduino, rainwater sensor and mobile application to help alert people when it is raining and take the necessary steps. Furthermore, the ideas conveyed through the system would inspire more authorities to look into the related concerns and take an initiative to implement this in real-life as it highly beneficial to the public. For future enhancement, this rainwater sensor system can adapt to more features and functions where a more user-friendly mobile app can be build.

Acknowledgements

A special thanks to INTI International University and Faculty of IT for supporting student's project and the submission of this work.

References

Bangalore, V. L. (2011). *U.S. Patent No. 7,966,153*. Washington, DC: U.S. Patent and Trademark Office.

Doukas, C. (2012). *Building Internet of Things with the ARDUINO*. CreateSpace Independent Publishing Platform.

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. *Future generation computer systems*, *29*(7), 1645-1660.

Hosoya, M. (2003). *U.S. Patent No. 6,663,769*. Washington, DC: U.S. Patent and Trademark Office.

Lee, S., Jo, J., Kim, Y., & Stephen, H. (2014, June). A framework for environmental monitoring with Arduino-based sensors using Restful web service. In *2014 IEEE International Conference on Services Computing* (pp. 275-282). IEEE.

Wohlfahrt, K. H., & Ebner, T. (2011). *U.S. Patent No. 7,911,356*. Washington, DC: U.S. Patent and Trademark Office.

Xia, F., Yang, L. T., Wang, L., & Vinel, A. (2012). Internet of things. *International Journal of Communication Systems*, *25*(9), 1101.

Yun, M., & Yuxin, B. (2010, June). Research on the architecture and key technology of Internet of Things (IoT) applied on smart grid. In *2010 International Conference on Advances in Energy Engineering* (pp. 69-72). IEEE.

Zaizen, M., Urakawa, T., Matsumoto, Y., & Takai, H. (2000). The collection of rainwater from dome stadiums in Japan. *Urban water*, *1*(4), 355-359.