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WEB-BASED SYSTEM FOR CONTROL OF ENVIRONMENT PARAMETERS[7]

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Abstract: *The papers combines knowledge in Computers (Operating Systems and Computer Hardware) with knowledge in the field of Electronics in University of Ruse. Building an IoT project requires knowledge of computer operating systems and basic programming and understanding how sensors are made, for example single sensor has analog input and receives some type of environmental data like temperature, humidity and then converts data to digits that computers can interpret. IoT becoms wide adopted in automotive industry, healthcare, home automation, werables, industrial and a lot more areas. All big names in IT indurstiry like Microsoft, VMware, Cisco, Amazon, HPE, IBM and many other companies are focusing on providing IoT cloud based services. Bulidling an IoT based Raspberry Pi project is relatively easy because a lot of sensors are ready for use and can be attached to the board directly, also there is wide support of program libraries for languages like C++ and Python. Result from sensors are visualised in IoT cloud, adding some functions it the code we can control relays, solenoids and many more execution mechanisms.*

Keywords: *Efficiency, IoT, Control system.*

INTRODUCTION

With the massive use of microprocessor engineering in control systems, the object management systems have a large-scale distribution (Evstatieva, N., 2010a), (Stoev, I., 2018), (Stoev, I., & Mutkov, V., 2018) as well as the monitoring systems (Evstatieva, N., 2010b). The advantage of microprocessor systems is the ability to collect information appropriate for process evaluation and analysis through monitoring systems. Taking into account the capabilities of modern microprocessor systems, the possibility of continuous control of processes and systems through mobile communication means comes into play. This is realized through WEB-based information

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systems. An example of such a system is (Yong. W., Shuaishuai L., Li L., Minzan L., Ming L., Arvanitis K., Georgieva Cs., & Sigrimis N., 2018).

The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators and connectivity which enables these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure. The whole idea is to use computer-based hardware which is capable of connecting electronics sensors directly to its board and can be controlled trough application code. Using comunication like Bluetooth, Wi-Fi, Ethernet, ZigBee, Lora WAN, 433 MHz Transmitters and Receivers, GPS modules, GSM modules, etc. The number of IoT devices increased 31% year-over-year to 8.4 billion in 2010 and it's estimated that there will be 30 billion devices by 2020. The global market value of IoT is projected to reach $7.1 trillion by 2020. IoT involves extending internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the internet, and they can be remotely monitored and controlled (Ray P., 2018).

The aim of the paper is to develop a Web-based system for control of environment parameters, allowing continuous control of environmental parameters as well as analyzing results by statistical processing.

EXPOSITION

Implementing and testing data from sensors

For testing purposes DHT 11 is attached to Raspberry Pi 3 B+, with correct Python libraries data coming from sensor is translated to binary code with following example:

40 Bit Data

0011 0101	0000 0000	0001 1000	0000 0000	0100 1101
High humidity 8	Low humidity 8	High temp 8	Low temp 8	Parity bit

Calculate:

0011 0101+0000 0000+0001 1000+0000 0000=01001101 Received data is correct:

Humidity: 0011 0101=35H=53%RH

Calculate:

0011 0101+0000 0000+0001 1000+0000 0000＝ 0100 1101

01001101≠0100 1001

The received data is not correct, give up, to re-receive data.

User host (MCU) to send a signal, DHT11 converted from low-power mode to high-speed mode, until the host began to signal the end of the DHT11 send a response signal to send 40bit data, and trigger a letter collection. The signal is sent. When MCU sends a start signal, DHT11 changes from the low-power consumption mode to the running-mode. Once the start signal is completed, DHT11 sends a response signal of 40-bit data and trigger a signal acquisition. Without the start signal from MCU, DHT11 will not collect temperature & humidity information spontaneously. Once data is collected, DHT11 will change to the low-power-consumption mode until it receives a start signal from MCU again.

Free status of data single bus is at high voltage level. MCU needs to pull down bus for more than 18ms to wait for response from DHT11 to make sure that DHT11 can detect the start signal. Once DHT11 receives the start signal from MCU, it will wait to send 80us low level response signal till the start signal is over. After the start signal from MCU is over, delay and wait for 20-40us, then read the response signal of DHT11. After MCU sends the start signal, it can switch to input mode or output high level, while the bus will be pulled up by the pull-up resistor.

When the bus is at low level, it indicates that DHT11 sent a response signal, after which, pull up the bus for 80us. When sending data, every bit of data begins with the 50us low-voltage-level and the length of the following high-voltage-level signal determines whether data bit is "0" or "1". Format is shown in the following diagram. If the response signal read is high level, DHT11 will not respond, please check the cable connections. After last bit of data is transmitted, DHT11 will pull down bus for 50us, then bus will be pulled up by pull-up resistor into free status.

Data decoding example.

If we decode the above data we have. Humidity 0b00101011.0b00000000 = 43.0% (43 is integral part and .0 is decimal part) Temperature 0b00010111 = 23C°.

Controling relay module from Raspberry Pi.

Raspberry Pi board have 40 GPIO pins wich are digital only. To control realy board we have added NPN BJT 2N2222 and 4.7 KΩ resistor.

Transistor as a switch

Transistor switches can be used to switch a low voltage DC device (e.g. LED's) ON or OFF by using a transistor in its saturated or cut-off state. Solid state switches are one of the main applications for the use of transistor to switch a DC output "ON" or "OFF". Some output devices, such as LED's only require a few milliamps at logic level DC voltages and can therefore be driven directly by the output of a logic gate. However, high power devices such as motors, solenoids or lamps, often require more power than that supplied by an ordinary logic gate so transistor switches are used. If the circuit uses the Bipolar Transistor as a Switch, then the biasing of the transistor, either NPN or PNP is arranged to operate the transistor at both sides of the "I-V " characteristics curves we have seen previously. The areas of operation for a transistor switch are known as the Saturation Region and the Cut-off Region. This means then that we can ignore the operating Q-point biasing and voltage divider circuitry required for amplification, and use the transistor as a switch by driving it back and forth between its "fully-OFF" (cut-off) and "fully-ON" (saturation) regions as shown below.

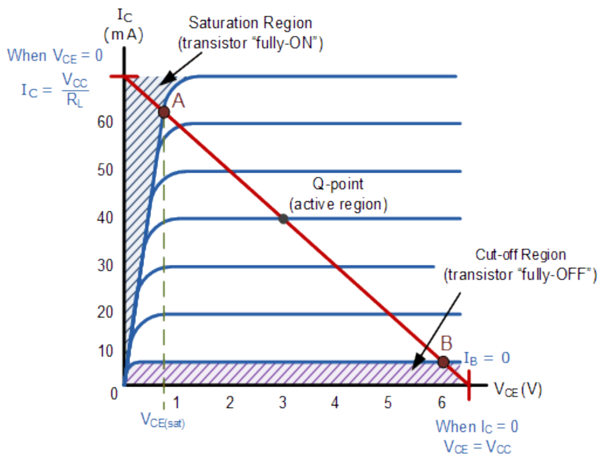


Fig. 1. The relationship between seismic forces first mode of vibration) (S_{1i}) and the stiffness of a damping bearing (K)

The pink shaded area at the bottom of the curves represents the "Cut-off" region while the blue area to the left represents the "Saturation" region of the transistor. Both these transistor regions are defined as: Cut-off Region

Here the operating conditions of the transistor are zero input base current (IB), zero output collector current (IC) and maximum collector voltage (VCE) which results in a large depletion layer and no current flowing through the device. Therefore the transistor is switched "Fully-OFF".

RESULTS

Prototype diagram

The prototype diagram is presented in Fig. 2.

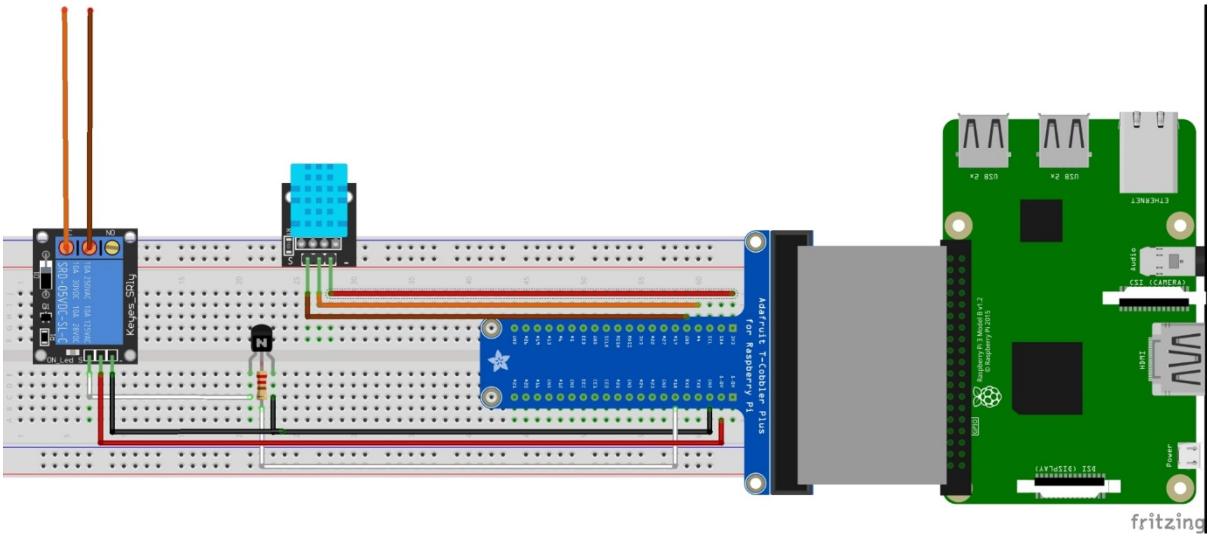


Fig. 2. Prototype diagram

Visualised data from IoT Cloud

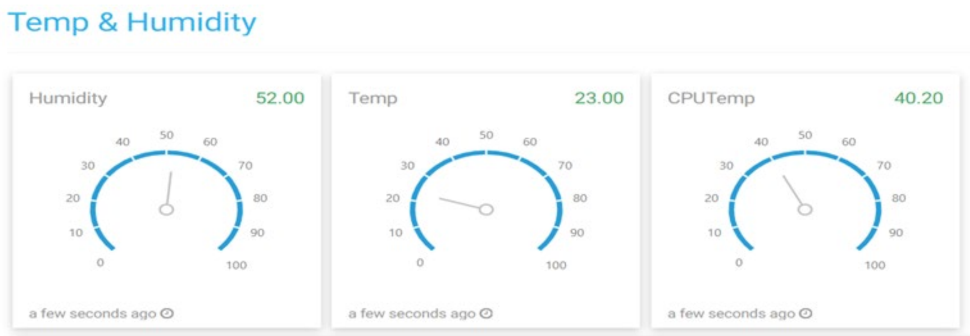


Fig. 3. Visualizing data from sensors using gauges and switch with logical 1

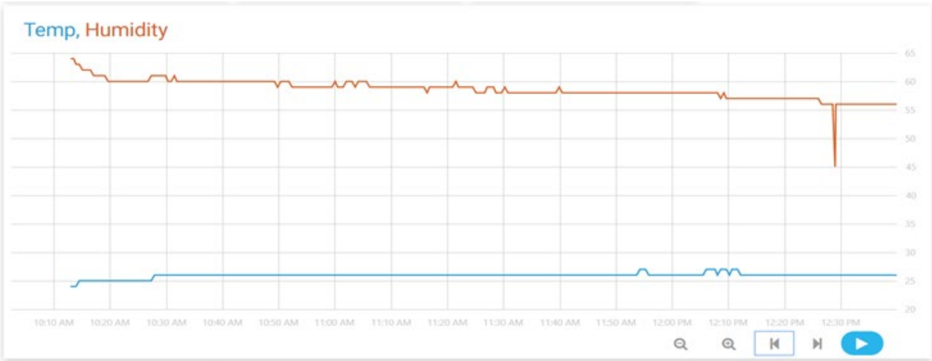
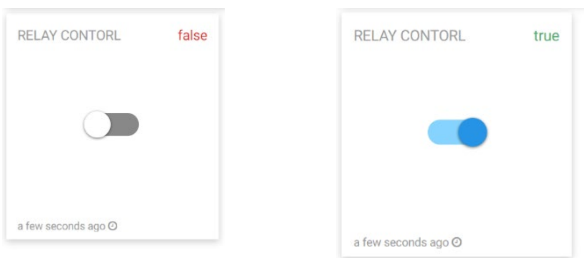


Fig. 4. Data visualization for certain period of time



Off position On position

Fig. 5. Controling relay module from IoT Cloud

CONCLUSION

Building IoT environemtal control unit can protect humans from harness of High temperatures and can control relay board when certain temperature is reached. Also, there can be added additional sensors like for certain type of gases, shock sensors, soil moisture, flood, rain, photo, PIR and lot more. This control unit is cost effective and can be modied as needed.

The building of high-rise houses in high-risk earthquake zones is in a great demand in the modern world. So, damping bearings with low horizontal stiffness allow fulfilling this demand. Thus, application of non-traditional methods of seismic protection in high hazard earthquake areas is especially effective for building hospitals, which require long-term operations and storage centers for fragile items or antiques.

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