DESIGN AND IMPLEMENTATION OF A RAIN WATER DETECTOR-ALARM SYSTEM

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ABSTRACT

From time immemorial humans used the sun to dry many things, a process known as sun drying. Sun drying is carried out in the farm, home, industry, laboratory, hospitals and other institutions for a number of reasons. These reasons range from totally eliminating water molecules from the things being dried, i.e. outright drying, like clothes, some farm produce, during building work, and in sculpture to exposing certain electronic materials/components directly to the sun so that the ultra- violet rays from the sun can cause some changes in the component, and in pharmaceutical/chemical industries where certain plants used for pharmaceutical purpose/chemicals are exposed to direct sunlight for a little while to cause some chemical changes in them and even at home sometimes when we open our windows to allow the sun rays to fall into our rooms to eliminate dampness, and allow for proper aeration. When rain falls, it will cause a setback to all the reasons for sun-drying enumerated above, especially when the materials being sun dried are not retrieved quickly. Thus, designing and constructing a device which gives one a heads-up the instant it starts to rain hopefully giving you time to retrieve the materials being sun dried, close your windows, and bring in possession is not only apropos but also absolutely imperative. The rain detector is a device that alerts the user when it is just about to rain. Minute droplets of rain water trigger the alarm, thus, alerting the user that rain is imminent. It is a battery powered device which combines sensors, a buzzer for the alarm system, silicon transistors, capacitor and other components in its circuitry to realize its purpose.

Key words: Rain water, microcontroller, embedded 'C' language, Buzzer.

1.0   INTRODUCTION

Mankind has always harnessed the elements of nature for different purposes. Water for irrigation and Electricity generation (Hydro Electric Power),wind for wind mill used for many applications ranging from turning turbines that generate electricity, to quarry for crushing stones, sun for drying, heating and cooking especially when brought to focus.

From time immemorial humans used the sun to dry many things, a process known as sun drying. Sun drying is carried out in the farm, home, industry, laboratory, hospitals and other institution for a number of reasons. These reasons range from totally driving out water molecules from the things being dried, outright drying, like clothes, some farm produce, during building work, and in sculpture to exposing certain electronic materials/components directly to the sun so that the ultra- violet rays from the sun can cause some changes in the component,and in pharmaceutical/chemical industries where certain plants used for pharmaceutical purpose/chemicals are exposed to direct sunlight for a little while to cause some chemical changes in them and even at home sometimes when we open our windows to

allow the sun rays to fall into our rooms to eliminate dampness, and allows for proper aeration.

When rain falls, it will cause a setback to all the reasons for sun-drying enumerated above, especially when the materials being sun dried are not retrieved quickly. Thus, designing and constructing a device which gives one a heads-up the instant it starts to rain hopefully giving you time to retrieve the materials being sun dried, close your windows, and bring in possession is not only apropos but also absolutely imperative. Also, since it can rain at any time without any warning, clothes in a clothes line outside the house that are almost dry may get wet if we do not realize it is raining on time. Thus, this project will also help house wives and other users to be quickly alerted to avoid rain from wetting shirts/ dresses being sun-dried at the clothes line outside the house.

2.0   LITERATURE REVIEW

For a number years up till date, some works on Rain water detection have been done by electronic designers/hobbyist. These works range from the application of rain detector circuit/device in irrigation, collecting rain water for domestic and industrial use a process known as rain water harvesting to using rain detector/Sensor in

automobiles to control the power windows and roof whenever it senses moisture a design known as automatic rain sensing windows.

P. Campbell, et al, [1] in their work, Automatic Rain sensing windows worked to create a device that will allow car windows to roll up automatically when it rains thereby preventing the interior from getting destroyed. The design was essentially used with automobiles. In [2] Campbell scientific built a rain detector which functions to detect whether it is raining or snowing, and the output used to control another circuit. In [3] Mohammed Hadi Ismail incorporated a rain detector in his work designed to harvest rain water automatically and store same in reservoir for domestic use. Other electronic hobbyists have designed one form of rain detector/sensor in the past but the main objective of this work which is detecting rain and alerting the user was never considered.

3.0 SYSTEM DESIGN

The design of the system is in two sections; namely, the hardware, and the software sections. The hardware section consists of the power supply unit, and the audio output unit which functions to alert the user of the presence of rain. The software section is essentially made up of an embedded 'C' language program containing sets of instructions that are transferred into the microcontroller, the heart of the project. These instructions carryout the specific functions of sensing the minutest drop of rain water and alerting the user of the presence of rain by triggering ON the audio output (Buzzer).
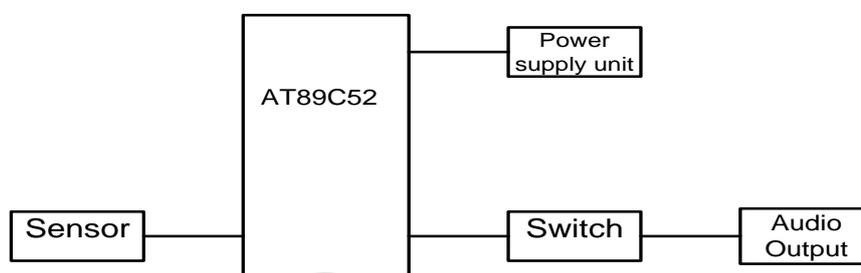
Figure 1: Functional block diagram of the system

3.1 Power supply unit

The power supply unit consists of a 9V battery for powering the circuit. The 9V supply is however regulated for use with the microcontroller by regulating it to 5Vdc supply for the microcontroller using a fixed voltage regulator LM7805.

3.2 Sensing unit

The sensor is essentially made up of a Veroboard which will receive the droplets of rain water and send signals to the microcontroller for processing. The veroboard's multiple interface which are also in close proximity with each other plays a vital role here. The board's stripes of interfaces were wired alternately such that all odd lines of stripes are linked, the even lines are also linked in same way. While the odd stripes are connected to Pin 7 of the microcontroller, the even stripes are connected to Vcc. This is so done so that whenever the veroboard receives even the minutest drop of rain water, both terminals are easily shorted and signal sent to the microcontroller .The microcontroller's Pin 22 which becomes high on receiving the signal drives the NPN transistor to saturation which consequently switches ON the audio output to alert user of the presence of rain.
A 10k resistor is connected to the sensing unit to serve as a pulldown resistor. A pull down resistor pulls a floating node to a logic level low, i.e. it holds the logic signal near zero when no other active device is connected.
(Also, a 1k resistor is connected between the base of the transistor and the microcontroller to limit the base current to a certain value)
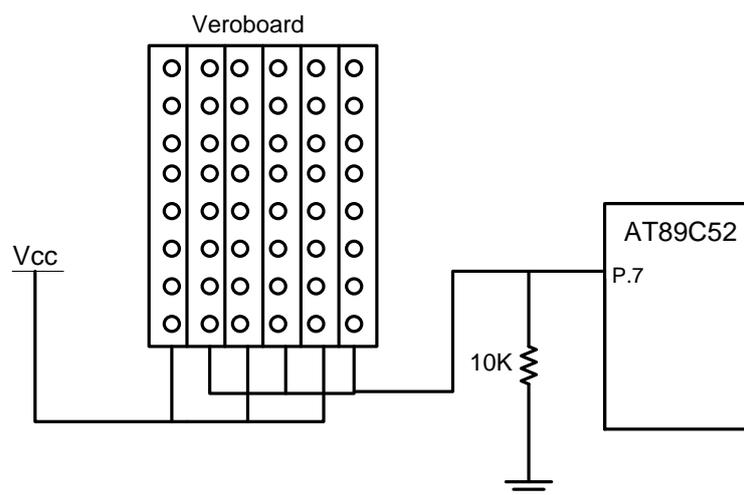
**Figure 2:** Sensor interfaced with microcontroller

3.3 Microcontroller unit

The microcontroller used in this work is AT89C52. The different units are interfaced through the ports of standard microcontroller (AT89C52). The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89C52 provides the following standard features: 8K bytes of flash, 256 bytes of RAM, 32 I/O lines, three 16 – bit timer / counter, a six vector two level interrupt architecture, full duplex serial port, on chip oscillator and clock circuitry. The extension ports can be done by using 8255 standard

PPI. Here a programmed AT89C52 microcontroller with embedded C language is used.

3.4 Switching and Audio units

The switching unit of this design is essentially an NPN, C945, and transistor. It is used for this work because the microcontroller cannot supply more than 5-10mA which is far less than what is needed to drive the output unit (Buzzer).The C945 has a typical DC current gain of 200mA at 1mA and a maximum of 0.15A.Thus,a typical base current of 200mA can trigger to turn On the buzzer. The switching and audio unit is connected to the microcontroller's (AT89C52) Pin 22 through the base of the transistor.When the base voltage (Signal from the microcontroller) appears at the base of the transistor, the transistor is driven to saturation and allows current to flow in the buzzer thereby turning it ON {Buzzing to alert the user of the presence of Rain}.The Buzzer used in this work is the 9V, 4KHZ, 17MM H8MM PCB mount Piezoelectric type.
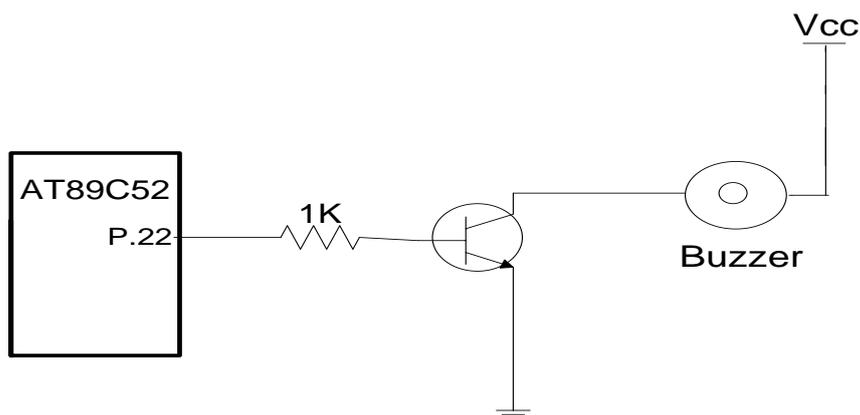
Figure 3: Switching and Audio unit

4.0   TEST AND RESULT

The designed rain detector-alarm system was tested for a period of ten rainy days to ascertain its reliability/functionality. The testing which was done before it started to rain revealed that the audio unit of the system was triggered ON even when the droplets of rain have not become visible to the human eyes, thus showing clearly that the system could detect the thinnest or minutest droplets of rain and alert the user accordingly, which is in agreement with the design objective.

4.1   TABLE OF TEST RESULTS

Table 1: Test Results.

DAYS	BUZZER ACTIVATION TIME [T1]	TIME IT STARTED RAINING [T2]	RECOVERY TIME [T3]=[T2-T1]
1.	16.00 hour	16.05 hour	5 minutes
2.	11.00 hour	11.07 hour	7 minutes
3.	14 .00 hour	14.03 hour	3 minutes
4.	09.00 hour	09.15 hour	15 minutes
5.	13.00 hour	13.20 hour	20 minutes
6.	15.00 hour	15.10 hour	10 minutes
7.	20.00 hour	20.06 hour	6 minutes
8.	18.00 hour	18.15 hour	15 minutes
9.	08.00 hour	08.09 hour	9 minutes
10.	21.00 hour	21.05 hour	5 minutes

4.1.1   Graph of reliability/functionality of the designed system
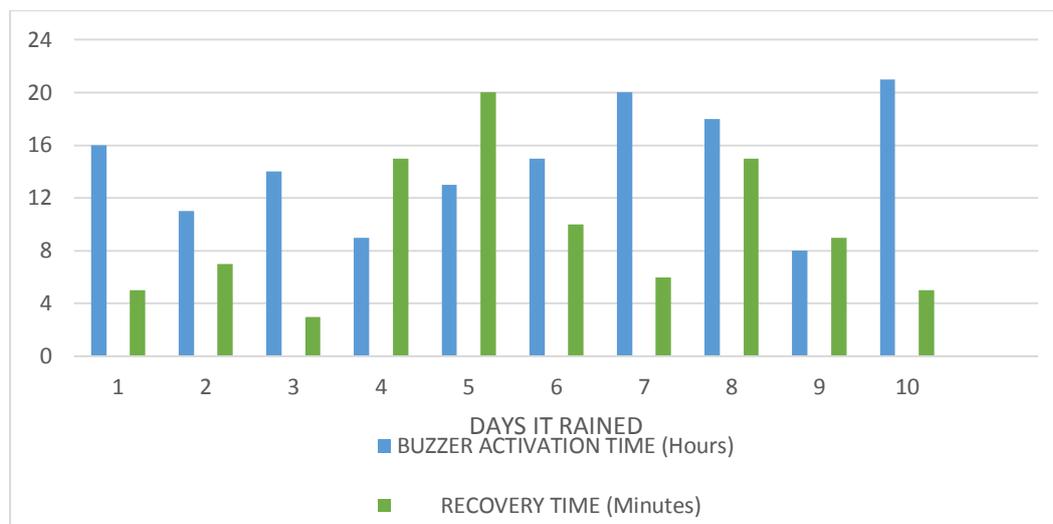
Figure 4: Graph of reliability/functionality of the designed system

4.2 DISCUSSION OF RESULT

From the table and the graph of reliability/functionality, it can be deduced that for each of the days it rained, the system alerted the user first before it actually started to rain thereby giving the user ample time to retrieve/recover possession and preventing them from being drenched by rain water. This time herein referred to as recovery time is the basis for this design.

5.0 CONCLUSION

The rain water detector-alarm system will be useful in both domestic and industrial applications. It alerts the user(s) of the presence of rain when it is just about to rain as even the minutest droplets of water triggers it 'ON' thereby giving the user ample time to retrieve possessions, shut windows, and in some cases prepare to harvest rain water.

The device when properly placed to receive the first set of droplets of rain water can save the user from damaging possessions that were being sundried/prevent rain from entering homes, offices, and silos to mention but a few.

6.0   REFERENCES

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