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# Fully Automated Sun Drying System for Food Grains

**Senthil Kumar R[1*], Harshavardhan Naidu S[2], Suguna R[1], Raghunandhan R[1], Poovendan V[1] and Sri Sai Vatsan R[1]**

[1]Department of Electrical and Electronics Engineering, Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College, Chennai, India.

[2]Department of Electronics and communications Engineering, Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College, Chennai, India.

Email: rskumar.eee@gmail.com, sapineniharsha@gmail.com, sugunaramesh2429@gmail.com, raghunandhan30062001@gmail.com, poovendhanvenkat@gmail.com, jayshriramesh23@gmail.com

## Abstract

The article was coined on objective of developing a fully automated sun drying system for various food grains. Hence food waste due to human error and manual monitoring can be reduced. Sun drying duration and temperature differs for various food grains, so it is necessary to adapt suitable drying duration for different grains, instead of having a common pre-set value. As the sun drying duration and temperature of grains have great impact on texture of grains which in turn are the deciding factors of quality grade of final product of grains. Another big issue is sun drying process is grains get wet due to unexpected rain which will delay the process or spoil the grains, creating huge loss. Hence a system is developed with Arduino and sensors to cover the grains immediately if rain is detected, monitor the temperature and drying duration. For validating the outcomes of the system, wheat grains are taken for study; system threshold values are set accordingly. System is tested for four objectives; they are in case of rain, if temperature exceeds permissible value, if drying period exceed the required period and under normal condition. On the whole system seems to be user friendly in changing the pre-set value which varies for different grains.

**Keywords**. Rain Sensor, Food Grains, Sun Drying, Arduino UNO, Temperature sensor, Automatic Protection.

## 1. INTRODUCTION

In 2017, according to New Delhi, around 57676 tons of food grains are wasted in the past five years, where the grains have got damaged, which were become useless, for the human consumption. Such a huge amount of food grains could be able to feed around 1.15 crore people for a month. In the last few days,

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thousands of tonnes of wheat got spoiled and wasted due to unexpected rain, in Ambala. Apart from that, wheat which was brought to the grain market, got wet and spoiled. The agencies faced a huge loss, and are struggling to provide cover to farmers to protect food grains from getting wet.

In 2016, the wastage of food grains has increased from 12 percent to 14 percent. Which is a huge difference and huge amount. The heavy down pour of rain has created a huge problem and burden to the farmers, where the farmers are forced to work in a heavily pouring rain, to remove and cover the grains from getting wet. It is not possible for the farmers, of anyone to collect the food grains from heavy rain in a matter of seconds. The farmers have faced a huge loss in many places of India, where the prediction of rainfall is unexpected.

Table 1: Drying temperature and duration for various grains

| Grains | Temperature in Celsius | Duration hours |
|---|---|---|
| **Maize** | 41.1 - 58.9 | 2.6 |
| **Wheat** | 35 - 40 | 2 |
| **Millets** | 50 – 60 | 0.40 |
| **Paddy** | 55 – 60 | 2 |
| **Rice** | 25.8 - 29.27 | 2 |
| **Beans** | 40-54 | 10 |
| **Cow peas** | 70 | 7 |
| **Copra** | 53 | 1 |

## 2. LITERATURE REVIEW

People are struggling when unexpected rain comes during cloth drying in the direct sun. So here is the simple and best invention of fully automated system for cloth drying under direct sun. The humidity sensors are used to monitor the humidity. It will detect the rainfall, by measuring the humidity. To measure and detect the average sun rays, PV sensors are used. AC motors are used for movement of cloths from one location to another location, with the help of microcontroller, when there is an unexpected rain. This automated system, is cheap, will reduce human effort [1-3].

The design of rain detector alarm consists of a switching unit, microcontroller, power supply and buzzer. Even if there is a smallest drop, the rain

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sensor can be able to sense the rain drop which is falling on the rain sensor. The power supply consists of 9V battery. IC has three modes called bi-mode, Mono stable mode, A-stable mode. As this IC is A-stable mode, there is no stable level of output. The buzzer is used for alarm, which indicate the user, in the form of sound when there is an unexpected rain fall. Double sided copper board are used in the construction of rain sensor. The rain sensor works as a switching device, when there is rain fall which causes the transistors present in the circuit to turn ON. So, this project makes the user, the simplest project, which reduces the time and made the job done quickly before heavy rain come [4].

In India, cricket is one of the most popular games in the world. But the problem is that, the cricket match gets delayed or get cancelled due to unexpected rainfall. To overcome such a problem, rain detector with alarm with automatic roofing system are used for Cricket Stadiums. The auto roof covers the entire stadium. The setup consists of Arduino UNO, servo motor, LED, Buzzer, GSM, and rain sensor. When there is a rainfall, the rain sensor activates and give signal to Arduino uno and GSM, which will turn on the buzzer to make sound and the LED to indicate, and the servo motor will automatically close the roof, which will prevent the Cricket Stadium from rainfall. When the rainfall stops, the roof will automatically open. And hence all the messages are sent to our respective smartphone [5].

Floods are caused due to heavy rainfall. Therefore, some tools and systems are used to monitor the rainfall. The Arduino uno is interfaced with temperature sensor, humidity sensor, and rain sensor to monitor the weather conditions. The whole setup will provide warnings and reports on the rainfall level, which is very useful for minimizing the amount of flood before the rainfall. We can make some arrangements, before the rainfall, which reduces the flood. Analog data signal from Arduino uno are sent to fuzzy interface. Using fuzzy algorithm, the data are processed. The device provides estimate of weather, to remain rain level detection [6].

## 3. PROPOSED METHODOLOGY

Figure 3.1 display the block diagram of the proposed system, it consists of Arduino Uno, rain sensor, temperature sensor, LCD display, keypad, driver circuit, motor and screen. Humidity sensor are used as the rain detector which is deployed for detecting the rain, temperature sensor is employed to monitor the temperature at which grain are dried under sun, as it is important to maintain the texture of grains, Arduino controller plays the role of brain in the system, as it is receives the input values and holds all preset value, with what it provides the control action as per the

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preset program. Keypad is provided to make system user friendly in varying the preset value as the grains considered for drying.

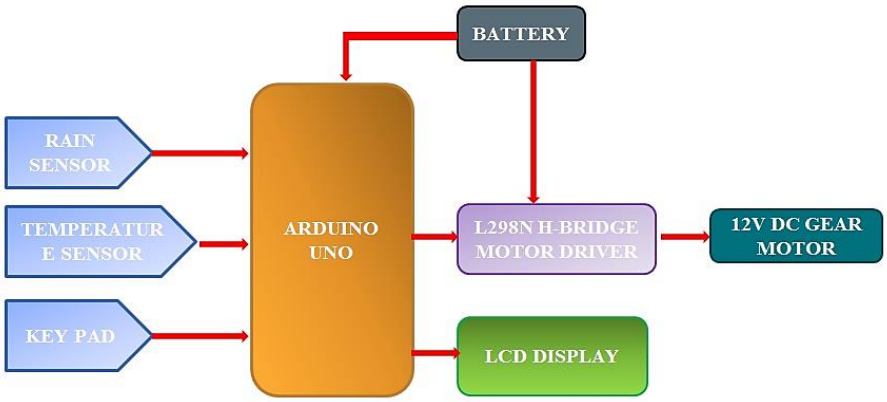


Figure 3.1. Pictorial representation of Proposed Methodology

The Figure 3.2 show case the process followed in the introduced system, as the Arduino controller has to process three parallel operations as the objective of the work demands monitoring of humidity, temperature and duration of drying. Humidity sensor continuously monitor the whether there is any rain fall or not. In case of rain fall sensor intimate the controller and controller will initiate the drive circuit to unwound the screen and entire grains will be covered.

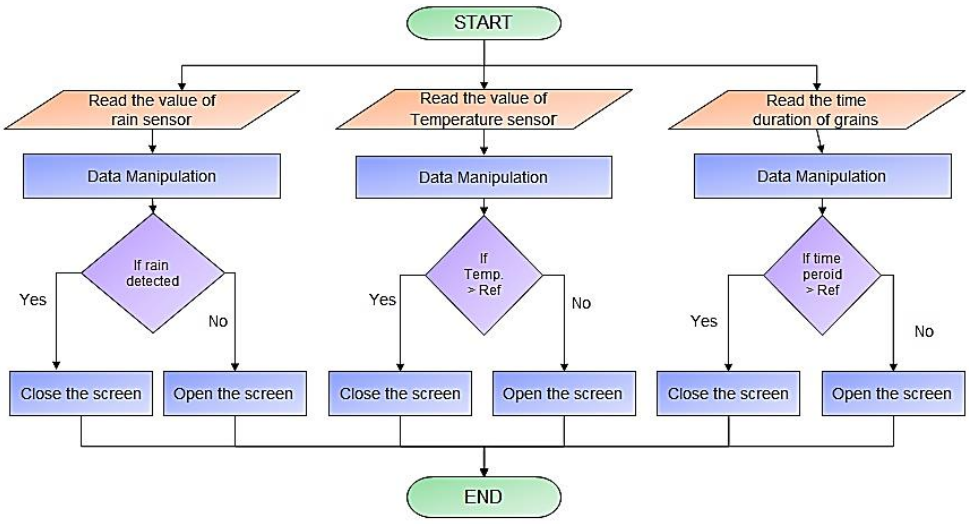


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Figure 3.2. Process flow chart of Proposed Methodology

Another task which as to be processed in parallel are constantly monitoring the temperature of grains under sun drying as it is very important in maintain the texture in which grains are required in the market. Incase if temperature exceed the preset temperature value of any particular grain, then controller will unwound the screen to cover the grains there by it will won't allow the temperature to exceed beyond the preset value of that particular grain.

The next objective which has to be monitored in parallel are duration for what the grains has to be dried under sun, for that controller will have the complete track record of duration for what the grains are dried under sun, which is very crucial deciding factor of the quality of the grains.

In case if duration of sun drying exceed the pre-set value controller will unwound the screen to coverup the entire grains which will maintain the expose time of the grain within the pre-set value.

Figure 3 display the hardware interface of proposed system hardware consist of input element as temperature sensor, humidity sensor and keypad. Temperature sensor continuously monitor the temperature of grains drying under the sun, humidity sensor will detect the rain. Key pad provides a flexibility to user to modify the threshold level based on grains dried under sun.

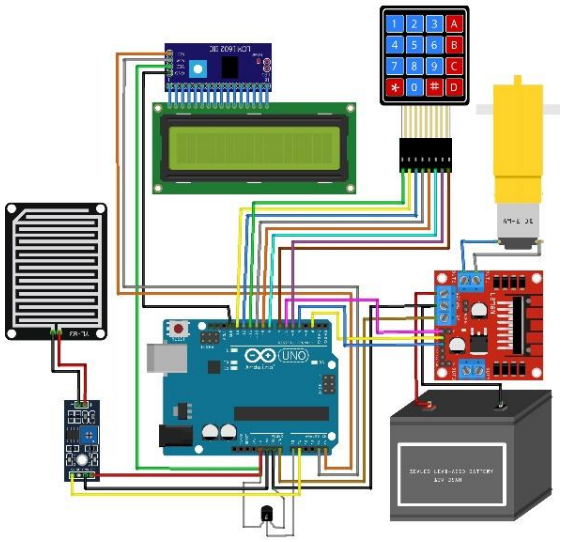

Figure 3.3. Hardware circuit interface

Here Arduino Uno is employed to control the entire system. Based on the condition as per the input what received controller provides the control signal to

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driver sytem system which covers the grains with screen and all actions will be displayed in LCD display [7-9].

## 4. RESULTS AND DISCUSSION

For validation wheat grains taken for study and reference as threshold for system are set accordingly, figure 4.1 display the plot for a day of monitoring the temperature and rain while drying the wheat grain, drying period was restricted between morning 8:00 Am to evening 5:00 Pm with an overall time period of 8 hour a day, rest hours screen remains covered.

Here blue colour marks indicates that temperature is within the permissible level, while red colour marks the point where temperature crossed permissible level hence system automatically covers the grains with screen to avoid direct insolation of sun ray on grains. While the yellow colour marks are the point when sensor had detected rain, during this occasion also system automatically covers the grain. There by grains are protected from being get wet.

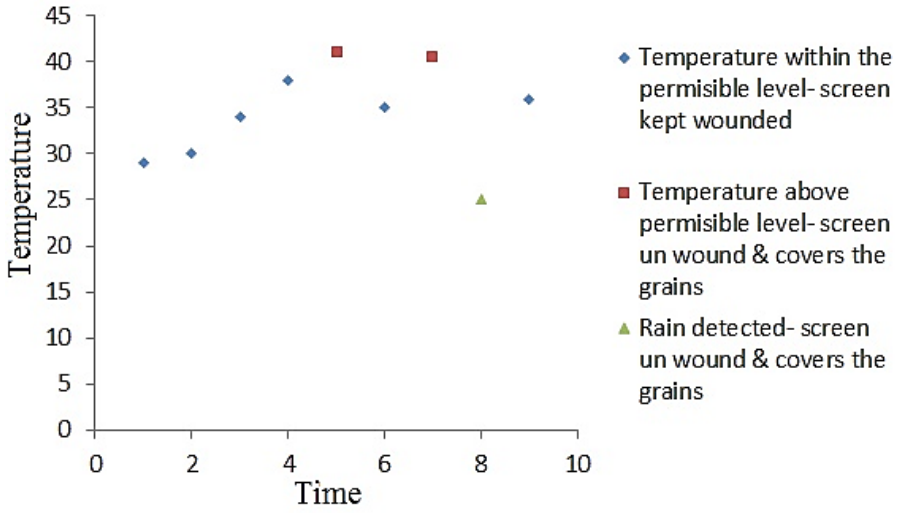


Figure 4.1. A day graph of sun drying

Table 2 show case the inference of the outcomes as per the conditions observed in the process of drying the wheat grains, all the four cases of study as per the objectives were evaluated. How the system reacted to following case are given in the table 2, first case under no rain and permissible temperature, second case if rain detected, third case if temperature exceed permissible temperature and fourth case if drying period exceed the required drying period.

Table 2: Outcomes and its inferences

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| LCD Display | Inference |
|---|---|
|  | LCD shows that, the rain sensor has still not detected any rain, so it shows "NO Rain". Hence when there is no rain drop on the rain sensor, the resistance value of the rain sensor is not less than the set value of resistance in the Arduino Uno code, the LCD display shows "NO Rain" screen remains uncovered allowing the grains to dry under sun. |
|  | LCD shows that, the rain sensor has detected rain, so the LCD display shows "Rain Detected". Hence when the rain drops fall on the rain sensor, the resistance value of the rain sensor is less than the set value of resistance in the Arduino Uno code, the LCD display shows "Rain Detected" immediately screen unwound and cover the entire grains protecting the grains from being get wet. |
|  | LCD shows that, the time duration of the particular food grains, that we have kept for sun drying has completed. The time duration of particular food grains and specific allowable temperature is monitored. Once the drying duration completed screen unwound and cover the entire grain. |
|  | LCD displays the temperature at which the food grains are drying under sun. If it exceeds the temperature value set to the particular food grains, then the screen closes, which stops sun drying. At the same time, the LCD display shows that "temperature exceed present value". As the temperature at which various grain to be dried differs, it becomes indispensable to monitor the temperature closely. |

## 5. CONCLUSION

The reaction time of the proposed system is around 2 micro seconds to detect the rain hence it is able to protect the grains from rain, before it is being getting wet by rain which seems to be fruitful in reducing the drying time and preventing grains

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from getting spoiled. For validating the outcomes of the system, wheat grains are taken for study; system threshold values are set accordingly. System is tested for four objectives; they are in case of rain, if temperature exceeds permissible value, if drying period exceed the required period and under normal condition. The study was carried over a day in monitoring the temperature and rain while drying the wheat grain, drying period was restricted between morning 8:00 Am to evening 5:00 Pm with an overall time period of 8 hour a day, rest hours screen remains covered, due to dew conditions. System proves to be most cost-effective solution to automate the drying process which demands constant manual monitoring. As the system is provided with additional features such as temperature and duration of drying monitoring helps in retaining the texture in which they are required to get the premium quality. System is also user friendly in varying the preset value as per various grains.

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