International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 01 | Jan 2019 www.irjet.net p-ISSN: 2395-0072

DESIGN AND DEVELOPMENT OF INTELLIGENT WATER HEATING SYSTEM

Haridnya Bandal[1], Pratiksha Shivekar[2], Sandesh Khaire[3]

[1,2,3]Student, Department of Electronics and Tele Communication, AISSMS's Institute of Information Technology, Pune. India.

Abstract - *The most frequently met difficulty, in a solar water heating system, is to obtain the hot water at a required time and temperature, due to variations in the incident solar radiations, over a day or even in the different seasons of the year. This paper presents designing of Intelligent Water Heating System with control mechanism based on the sensed temperature of solar water with user defined timings. This mechanism proposes a solution to the problem of obtaining warm water at a desired temperature and at desired time. Further, the energy consumption is also reduced by using a hybrid mode (using a solar water heater and an electric heater), where the preheated water by the solar water heater is used. As a result, the electricity expenses of the electric heater can be curtailed. The user can set desired temperature and time period for which hot water is expected, by sending SMS to the system and rest all process will be carried out by system. This makes the system user friendly and effortlessly without much intervention of user.*

Keywords: Intelligent water heating system (IWHS), solar water heater (SWH), Auxiliary heating system (AHS).

I. INTRODUCTION

Since atavistic times, solar energy has been harnessed for the welfare of mankind [1]. The use of solar technology has increased at a rate of about 30% yearly, since 1980. Use of solar energy can not only reduce the gap between demand and supply of energy, but can also financially benefit the users by reducing the running costs of the appliances. Solar water heating system is one of the simplest ways of utilizing solar thermal energy. Renewable Energy Policy Network, in 2010, has reported that about 70 million residences are now using solar water heating (SWH) systems worldwide. Due to their low capital investment and almost zero or nearly negligible maintenance value as compared to other conventional ones, they are deemed cheaper. The economic benefits of the utilization of SWH can mainly be realized through savings in fuel costs for water heating and environmental issues. SWH systems are becoming widespread and are now contributing significantly to both domestic and industrial sectors in several countries. These systems further contribute towards reducing environmental pollution and maintaining ecological balance. The utilization of hot water depends on its use whether domestic or industrial, and also on seasonal variations like summer or winter. Process heating and space heating are the main applications of hot water in industries where each process requires water at different temperatures. Domestic hot water utilization mainly depends on the geographical condition, the country's customs, and type of building usage and on the lifestyle of the inhabitants. The main hurdle in utilizing solar thermal energy for a specific industrial or domestic application is the uncertainty of output, in spite of much modification done to the systems in terms of heat exchanger, storage tank, tube spacing and materials used in their construction. The temperature of the water from the SWH is not stable, due to the unreliable nature of the solar radiation. It is difficult to operate an SWH naturally to fulfill the hot water requirement at a particular required temperature and time during overcasts, due to variation in incident solar radiation. Also, thermal stratification in the storage tanks is another area which seeks attention. One possible solution to this problem is to employ an auxiliary heating system (AHS) coupled with the SWH which enables the user to obtain water at a higher temperature. Therefore, in order to use an SWH in output specific applications, a reliable control mechanism is required for integration with the auxiliary heating system. In order to get the intended output, the mechanism should be able to continuously monitor the output of SWH and automatically take appropriate decision of controlling the operation of AHS timely. A controller is expected to serve this purpose effectively in terms of providing warm water at desired time and temperature as per users' need. This paper is organised in the following manner. Section II presents block diagram and description of IWHS, Section III presents development of flowchart and section IV includes the conclusion and future work of the system.

II. BLOCK DIAGRAM DESCRIPTION

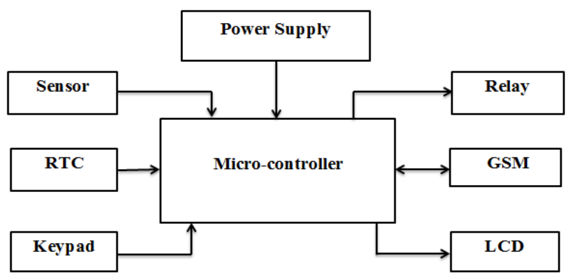

Fig. 1: Block diagram of IWHS

Fig 1 shows the block diagram of IWHS. The control mechanism is microcontroller based, which employs an elementary PIC18F4550 microcontroller. Microcontroller is programmed to take the appropriate decision for providing warm water at desired time and temperature. Sensor is expected to continuously sense the temperature of water from SWH and provide temperature status to microcontroller. Out of the different sensors available for the purpose of sensing temperature, Pt100 temperature sensor will be used for this work. Keypad is provided for user interfacing purpose. The user can enter desired temperature and time at which he expects hot water. LCD is used to display temperatures and timings. The GSM is used to update/alert the user with system control status. The user can also set time and required temperature from his/her mobile phones by sending a SMS to the system GSM module. GSM makes the system more convenient and user friendly. Relay is used to switch ON/OFF the AHS.

III. DEVELOPMENT OF FLOWCHART

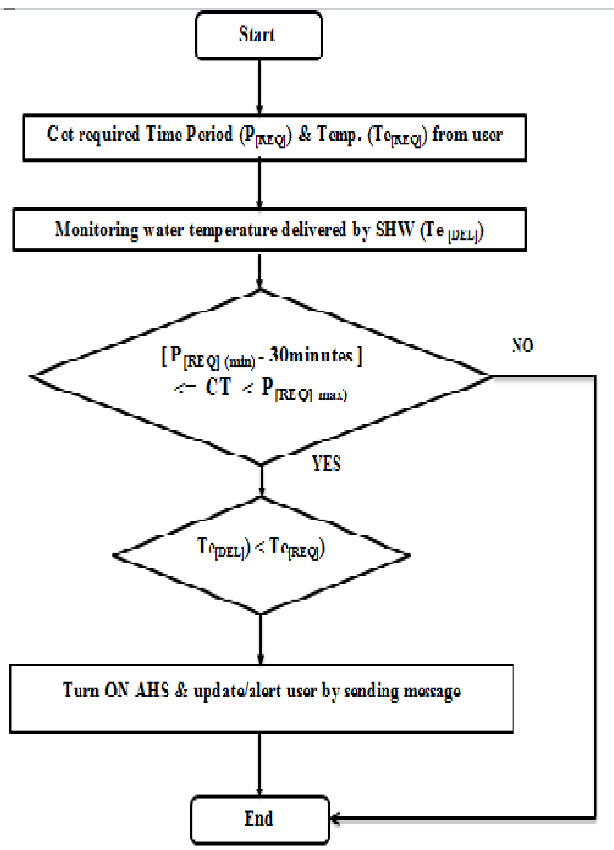

Fig. 2: Flowchart of IWHS

Fig.1 shows the block diagram of IWHS which forms the basis for the development of the above flowchart (Fig. 2).

Once the system is started, it will check whether required time period and temperature is already stored. If not stored previously, it will ask user to enter required time period **$P_{[REQ]}$** and temperature **$Te_{[REQ]}$** . (For eg: **$P_{[REQ]}$** = 6am to 8am, **$Te_{[REQ]}$ = 40°C)**

IWHS will do following steps:

1) Minimum time period **[$P_{[REQ]\ (min)}$] – 30 minutes (** For eg: $P_{[REQ]\ (min)}$ - 30 minutes = 6am - 30 minutes = 5:30 am). The time 30 minutes, depends on the quantity of SWH tank and time taken to heat that much water.
2) The current time from RTC is compared with minimum and maximum of required time period. (For eg: **$P_{[REQ]\ (min)}$** = 6am, **$P_{[REQ]\ max)}$** =8am.)

$$[\ P_{[REQ]\ (min)} - 30\text{minutes}\ ] <= CT < [\ P_{[REQ]\ max)}\ ]$$

If the above equation is satisfied system proceeds to next step otherwise ends here.

3) The system then compares the delivered temperature of water from SWH (**$Te_{[DEL]}$**) with required temperature **($Te_{[REQ]}$).**

$$Te_{[DEL]}) < Te_{[REQ]})$$

If the above condition is satisfied the Relay is turned on making the AHS switch ON and send user the current water temperature along with time required to reach desired temperature. If the above condition becomes false, the process is ended without switching ON Relay.
(For eg: Thus, the system will provide hot water of 40°C from 6am to 8am which is probably bathing time of common man. Also if the user wants to clean households like oily utensils at 4pm, he/she just has to SMS the system with the required temperature and time.)

IV. CONCLUSION AND FUTURE WORK

- The work described can be a potential candidate for the efficient usage of a solar water heating system. The world reserves will be decreased, which requires and encourages the use of solar energy and its exploitation as primary source. Water can be obtained at the desired time and temperature with negligible manual involvement during the process. The simplicity of the control mechanism will enhance its performance and makes it user-friendly.
- The inclusion of AHS to SWH will not only act as a value addition to the SWH, but, will help totally resolve the issue of obtaining water at the desired temperature, increasing the efficiency of the overall system. The GSM helps the user attain hot water without much intervention thus avoiding delay effortlessly.

- The future work can include, inclusion of IOT in IWHS by developing an application or webpage to set desired time and temperature, this will ease user to control IWHS anytime and anywhere.

V. REFERENCES

1) Washima Tasnin, Pradyumna Kumar Choudhury"Design and Development of an Automatic Solar Water Heater Controller"

2) Hasan, M. R., A. Rahman, and A. Azad. "Feasibility and importance of an automatic controller for solar hot water system." In Global Humanitarian Technology Conference (GHTC), 2011 IEEE, pp. 257-262. IEEE, 2011.

3) Azzouzi, Messaouda. "Control of solar water heater design."In Environment and Electrical Engineering (EEEIC), 2011 10th International Conference on, pp. 1-5. IEEE, 2011.