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Sustainable Houses of Bangladesh

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Abstract

Bangladesh is a developing country of South East Asia where awareness is low about sustainable living. This economic condition of her people is reflected in their daily life and activities including the house they live in. With the growth of their economic condition, they gradually shift from Tin-Shed houses to Brick-Built Buildings. In this study, we consider the Tin-Shed and Brick-Built building's thermal variability and inside heat index, and try to find out the human comfort zone. We have developed a system containing temperature and humidity sensor to collect data from different kinds of houses to check their heat index. Our work will allow general people to make their living decisions based on comfort level as well as sustainability.

Keywords: Sustainable Living, Living Comfort, Tin-Shed, and Brick-Build House, Environment Bangladesh

1. INTRODUCTION

Bangladesh is a developing country of South Asia, having a population of more than 160 million [8] where living space and conditions are often challenging. Here, living conditions reflect the social status, which in turn, plays a vital role in everyday life. Bangladesh is a compact country considering its area of living and population, where compactness brings frustrating aspects to daily life [9]. People moving from a mud house to a tin shed house (CI Roofed House) are considered to have had social improvement. However, they fail to consider the environmental factors, living conditions along with sustainable living whereas, sustainable form of living is more important for physical and mental health [9].

This research work builds upon the hypothesis of studying environmental parameters among different living spaces throughout the span of a day. Currently, we have considered a) Brick-Built House, b) Tin-Shed House for our field experiment. Though it has been proved in some research work that mud-built houses are more thermally efficient [3, 4], we will still consider it in our future work. The entire data collection has taken place through our custom-built Internet of Things (IoT) enabled system to continuously study temperature and humidity.

Current studies under limited time spans have revealed that the temperature and humidity differences show different level of variability under different conditions in brick-built houses and tin built houses. Tin shed houses show higher level of temperature which remain high during the evening. Again, it has health concerns on the people residing in those houses, considering the tropical weather of Bangladesh. In summary, the contribution of this research is that it explores the sustainable living conditions in the context of Bangladesh, and the findings of this study can be improved and extended in future work.

2. RELATED WORK

Various types of houses are constructed in Bangladesh that varies from region to region. Basically, brick-built houses are made in urban areas and tin-shed and mud build houses are common in Bangladesh. Though the indoor environmental changes are visible in several types of houses, a number of research works demonstrate the thermal comfort inside the houses that are built with several materials. In modern times, cement, steel, bricks etc. are used to replace the local materials as wood, stone, mud, tin, lime etc. for higher durability, and low maintenance [2]. The thermal performance was not considered in the past few decades that results poor thermal comfort in living [2].

Several research studies of Bangladesh show the thermal variety between mud houses and CI roofed brick-build houses, where it proved that CI roofed houses are less comfortable to live considering the temperature [3, 4]. It also varied in different times of the day. In the past, mud build houses were popular everywhere as well as in the Indian subcontinent [1]. However, material like mud bricks are environment-friendly, having higher thermal capacity, and considered as heat sink in unfriendly weather condition [1]. Though mud houses are not well enough in extreme weather conditions, and CI roofed houses are not also thermally friendly to live. That is why mud-brick build houses are recommended. We found similar variety in our study.

There have been development in several microcontroller-based units in other countries to sense temperature and humidity. ZIGBEE based LWSN and WSN sensing, monitoring and controlling system have been developed to sense the humidity and temperature of greenhouses in western countries [5, 6]. Some research proposed a number of models of smart sensing systems too. In previous studies based on Bangladesh, the use of sensors and data logger devices can also be seen [3, 4]. In this research, we introduced Arduino based simplistic temperature and humidity monitoring system that is reliable and cost-efficient system considering the context of Bangladesh.

3. METHOD

Study Parameters: The study is conducted in a brick-built house and tin-shed house studying the temperature, humidity over three different time periods of the day showing parameters in the morning (8 AM), noon (12 PM) and evening (5:30 PM) – taking around 50 to 60 readings during each time frame.

Location: The locations of the study are both in Dhaka city of Bangladesh. It is noted that we have not been able to conduct the study in mud houses, we hope to do so in our future work. The houses are shown in Figure 1(a) and Figure 1(b).

(a) (b)

Figure 1(a) Brick house (b) Tin shed House

Study Apparatus: The field test is conducted using our custom-built low-cost Internet of Things (IoT) enabled technology that continuously monitors temperature and humidity and stores it in a local storage. To develop this, we used widely available low-cost hardware. The major components are a) Arduino Uno Development Board, b) DHT11 Temperature & Humidity Sensor, c) RTC3231 Module, and d) Micro_SD Card Adapter as shown in Figure 2. In this system, temperature & humidity data is collected from the DHT11 sensor. Time and date are collected from RTC3231 adapter and finally, those datasets are logged into a micro-SD card attached to the system via a micro-SD card adapter for further analysis. Our Study findings are presented in the following section.

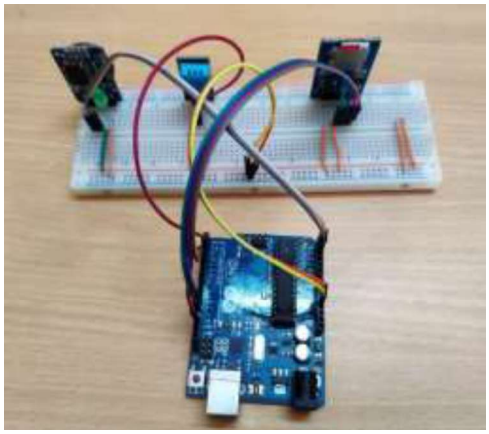

Figure 2 System Implementation

4. FINDINGS

The differences are clearly visible in environmental parameters in brick-built houses and tin-shed houses.

Morning Time Study: In the morning time study, it is shown that the temperature was comparatively stable in the brick-built house while the temperature slowly increased for the tin-shed house. Humidity was in reverse direction as of temperature while the tin-shed house showed higher values, compared to the brick-built house. The values are shown in Figure 3 (a) and Figure 3 (b).

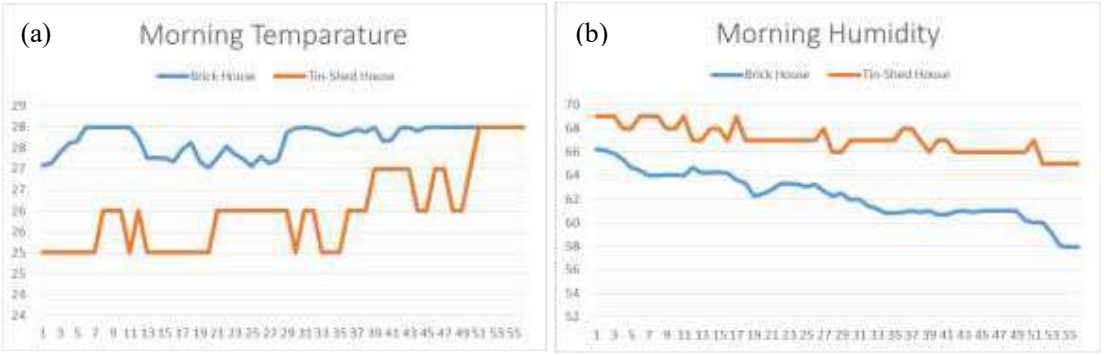

Figure 3 (a) Morning Temperature (b) Morning Humidity

Afternoon Time Study: Major temperature difference is visible in noon when the temperature raised. Higher temperature can be observed in the tin-shed house compared to the brick-built house, while the humidity remains similar in both environments, as shown in Figure 4 (a) and (b) respectively.

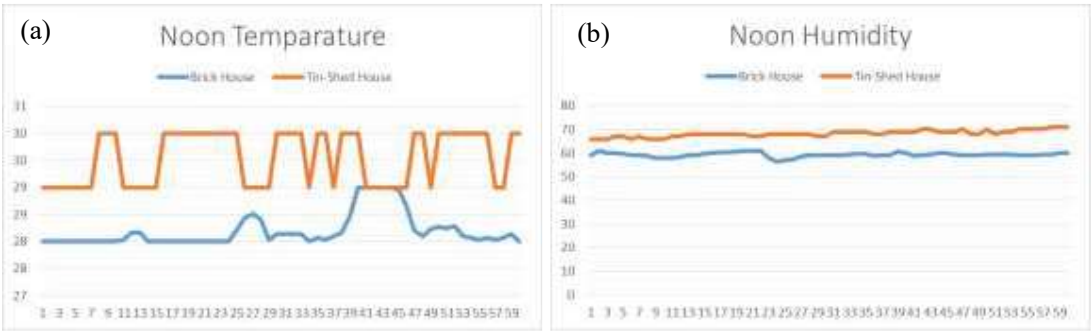

Figure 4 (a) Noon Temperature (b) Noon Humidity

Evening Time Study: The temperature was high in tin shed house even in the evening when the temperature dropped to a relatively lower level. The difference of humidity rises again during this time as shown in Figure 5 (a) and (b).

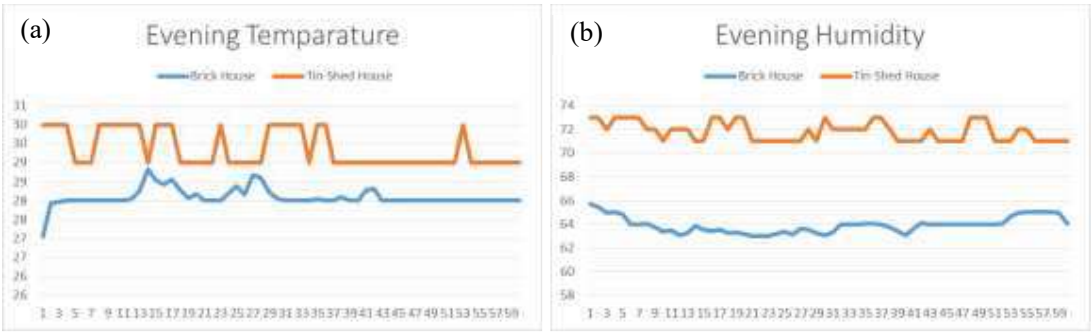

Figure 5 (a) Morning Temperature (b) Morning Humidity

Summary: The heat index shown in Figure 6 (a), (b) and (c) showing temperature during morning, noon and evening. It shows the environmental concern that tin-shed house always stays in higher temperature throughout the day, while the temperature of the house rises once.

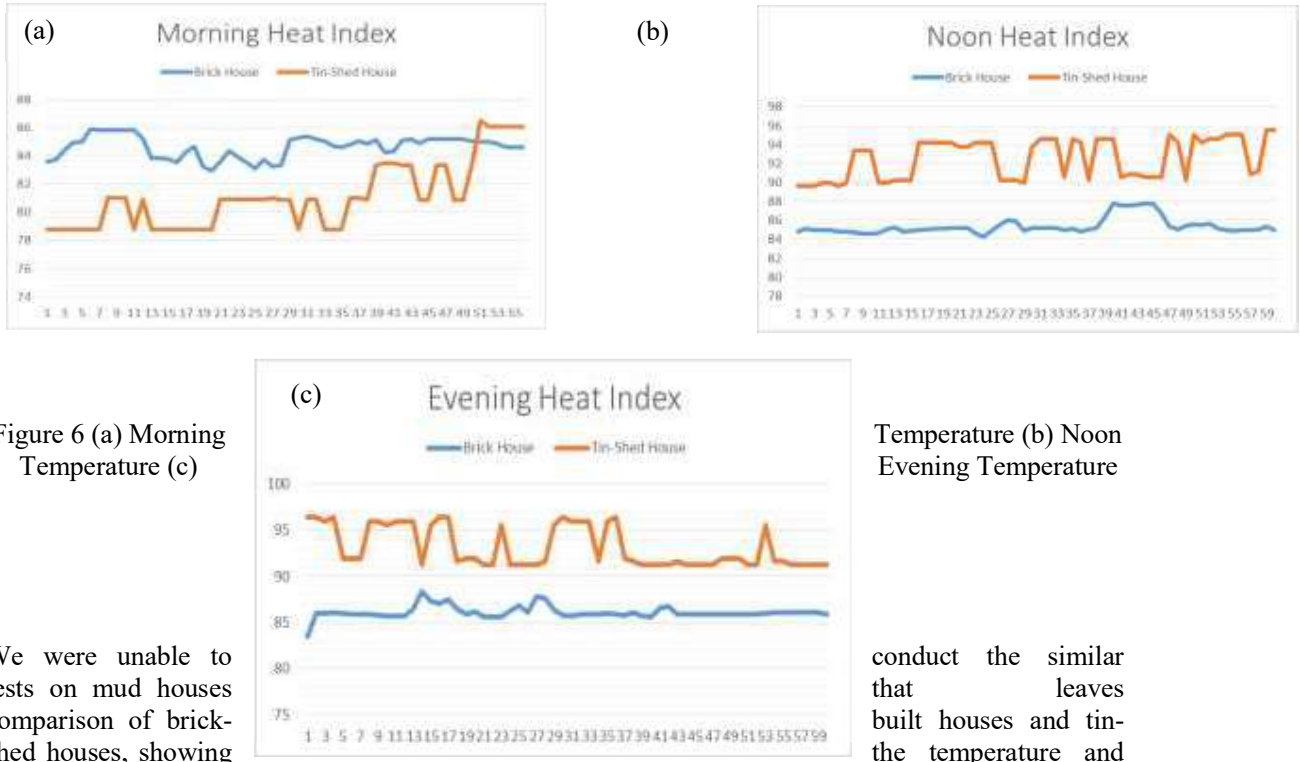

Figure 6 (a) Morning Temperature (b) Noon Temperature (c) Evening Temperature

We were unable to conduct the similar tests on mud houses that leaves comparison of brick-built houses and tin-shed houses, showing the temperature and humidity variability that are impacted from environmental conditions.

5. LIMITATIONS

Current studies only include the result of the comparison of tin shed houses and brick-built houses without any exploration of the mud houses. The study observes environment for a short period of time which is intended to consider long term studies in future. Similarly, the study should be conducted in several locations in Bangladesh that would open up regional contrasts.

6. CONCLUSION

We have explored the current living conditions and the environmental factors using low-cost sensing devices considering brick-built houses and tin-shed houses. It appears that tin-shed houses are more popular choice among the people of Bangladesh. Our further analysis shows extreme temperature readings of tin-shed houses that has negative impact on wellbeing of the residents of the house. We tried to consider mud-built houses too, but could not conduct our long-term data collections in such environment. Our research work will guide people to take decisions on sustainable living in proper houses. We hope to extend the current study and explore further.

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