The Applied Microcontroller in the Developing Urban Agriculture: A case study

Thanh Tung Nguyen[1*]

[1]Institute of Southeast Vietnamese Studies, Thu Dau Mot University, No. 6 Tran Van On Street, Phu Hoa Ward, Thu Dau Mot City, Binh Duong Province, Viet Nam

Abstract. Urban agriculture (UA) is a global development trend that is particularly prevalent in Vietnam. It offers numerous useful advantages, both now and in the future. Urban agriculture has developed primarily as a result of population growth and high levels of urbanisation, the need for clean agricultural products, the desire to reconnect with nature after working long hours, and, most importantly, contributions to air regulation to counteract the greenhouse effect, the creation of green spaces for contemporary architectural landscapes, and the treatment of urban wastewater to reduce local and regional flooding. In this piece, we offer a few realistic, efficient, and reasonably priced uses for microcontrollers in international investments that are appropriate for modest homes and communities right now.

1 Introduction

According to United Nations predictions, by 2050, 68% of the population on Earth will live in cities [1]. Humanity must simultaneously solve the problem of climate change and provide enough food to survive. The researchers looked at issues such as urbanization trends and from the limited space in urban areas as well as the agricultural methods that would be used [2]. On the other hand, climate change significantly affects migration and changes in unpredictable temperature and weather patterns. Rural people who find it more difficult to make a living go to larger cities in search of jobs and other opportunities [3]. Urban development requires a lot of land. Limited space can promote the idea of increasing agricultural production through adaptation to climate change, using disease-resistant crops [4]. Extensive industrialization affects agriculture, which in urban areas requires less land due to superior land prices and limited space [5]. The year was 2007, when more than half of Earth's population moved to cities for the first time. Urbanization, urban poverty and environmental pollution are all increasing in many emerging countries; Food insecurity and malnutrition – especially among women, children, pregnant and breastfeeding mothers – are all on the rise and unemployment is also rising. Urban agriculture offers opportunities to enhance social integration, local economies, health outcomes, food supplies and environmental sustainability [6]. Estimates show that urban agriculture can meet 15–20% of the world's food

*Corresponding author: nttung@tdmu.edu.vn

needs, and the ability to self-produce food for city residents is still difficult [7]. By 2030, 670 million people in Africa will be urban residents [8]. Due to rapid urbanization, the demand for food, water, electricity, sanitation and urban services is increasing. Research indicates that by 2030, worldwide food demand in urban areas will increase [9–10]. Urban agriculture can be considered part of the solution for cities [11]. On the other hand, irrigation helps increase urban greenery, reduce poverty, increase food security and promote greener economic development in cities [12–14]. The issue of creating agricultural production models appropriate for the soil and environmental circumstances in urban areas has arisen in Vietnam as a result of the country's recent rapid urbanisation drive. In addition to providing food for people, the use and advancement of urban agricultural models increase the amount of green space available to urban dwellers. In Vietnam, urban agriculture models are evolving into two categories: formal agriculture, which involves organized production in large spaces like farms and specialized production areas in the suburbs, and informal agriculture, which occurs when households use the small amount of space they have to raise livestock and grow crops. However, the effectiveness of these models remains modest, particularly the informal agricultural model. In an environment that restricts land funds for sustainable urban agriculture development, the use of advanced technology in agricultural production is essential for increasing productivity and product quality, cutting expenses, and making financial savings. Using their own products can save money for those living in cities [15–16].

2 Method

Today, in agricultural production in general and urban agriculture in particular, people know how to apply scientific and technical advances in farming and producing agricultural products to serve food needs. Pharmaceuticals and flower plants have been developed to be less costly in terms of cost and care time, all while maintaining high harvest yields. Our assessment divides the use of technological equipment in agricultural production into three levels:

a) Level 1: This level is specifically designed for large-scale fruit and vegetable gardens. People only use a timer to power the pump to water plants at a certain set time.

b) Level 2: Apply the device to small and medium-sized fruit and vegetable growing areas, like the terraces of houses or small plots of land adjacent two houses in urban areas, without incurring excessive costs. At this level, people use Arduino or Wemos D1R2 with soil moisture and DHT11 sensor. The central processing CPU circuit can provide a suitable response solution based on the input signal received through the DHT11 sensor. When the environmental temperature and air humidity surpass the pre-established threshold, the DHT11 sensor records, the changes, the Wemos D1R2 circuit regulates the mist spraying system, and the fan initiates operation. After a period of time, the temperature and humidity meet the plant's requirements, similar to devices that will stop working when the parameters stabilise.

c) Level 3: To meet strict quality standards for agricultural products or medicinal herbs, it is necessary to design a house with glass and steel frames. We must also consider the use of automatic fertilizers and trace mineral fertilization methods. In this case, people use many types of sensors, including light sensors or sensors that detect some substances that are not good for the output product (See Fig. 1).

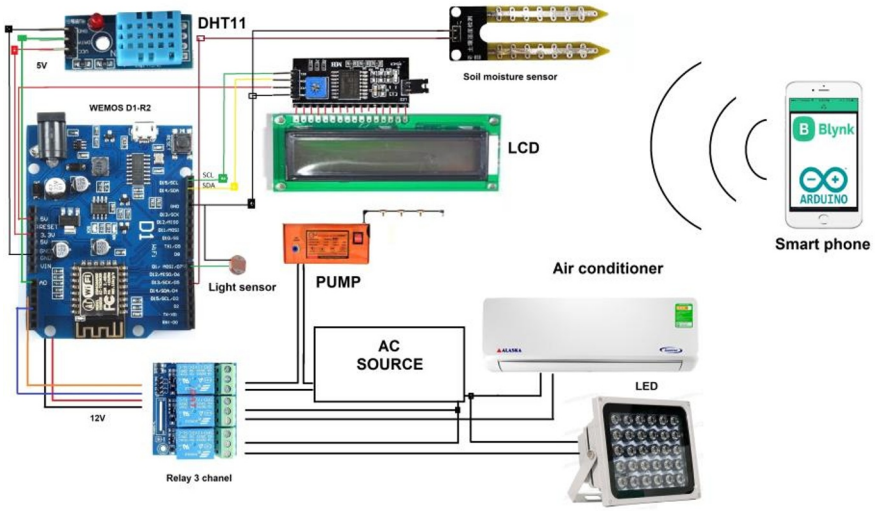

Fig 1. Electrical circuit wiring diagram for level 3

3 Result and discussion

Given the typical conditions for growing vegetables on the terraces of townhouses in urban areas across Vietnam's cities and provinces, we often design and install corresponding small equipment models at level 2. It's simpler not to use a soil moisture sensor. The simple sensor system includes the DHT11 and Wemos D1R2 modules, which have the function of transmitting signals via WiFi that users can read on the Blynk application using a smartphone (see Fig 3). With this design, we write code with the criteria of setting thresholds for three parameters: air humidity and ambient temperature. Specifically, the Blynk display screen will display a green light to indicate a normal state when the temperature reaches the maximum allowable threshold of 30°C and the air humidity reaches 70%, which is the optimal temperature and humidity for plants in general. If for some reason the temperature is higher than 30^{o}C or the humidity is higher than 70%, the light on the Blynk screen will turn red and combine with a warning signal on the smartphone to notify the user use. In addition, depending on the location of the device, we can install warning lights (or sirens) to notify users when environmental conditions are unsafe, as mentioned above.

The CPU triggers the mist pump to function when the humidity surpasses the threshold, spraying raindrop-like water to irrigate the plants. After a period of time, the humidity gradually increases to the normal allowable threshold, at which point the pump turns off and the Blynk screen returns to green lighting. Similarly, when the temperature rises above 31.3^{0}C, the ceiling fan is powered, and the humidifier pump also operates. The operating process is similar; it essentially ensures the stability of the living environment for plants. However, to prevent heavy winds and rain, we combine a protective net system around and above so that vegetables and fruits are not affected in the most cost-effective way (See Fig 4).

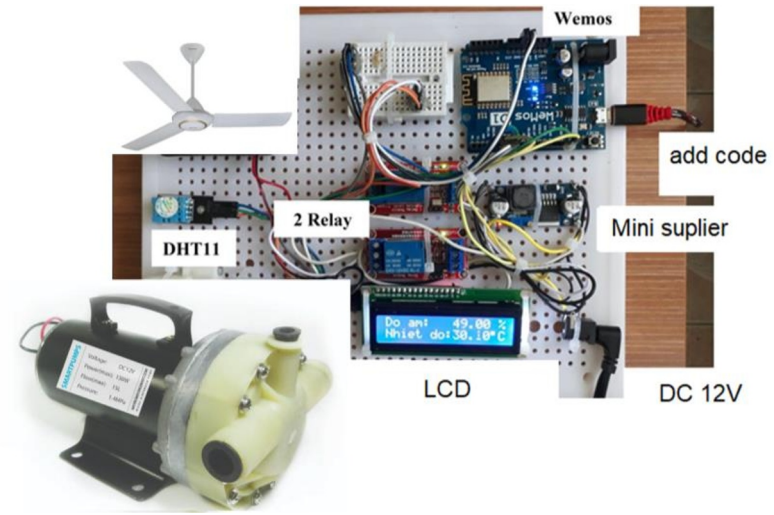

Fig 2. Picture of mini applied system for level 2

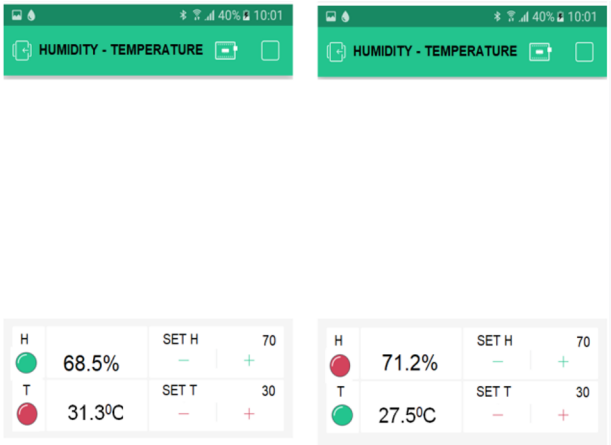

Fig 3. Result humidity and Temperature on Blynk

Fig 4. Picture of a rooftop vegetable garden with a microprocessor application

4. Conclusion

Within the limits of this article, we have not described or presented in detail, but only given some basic information and brief comments as follows: For simple level 2 microcontroller applications, the cost low, we have achieved the goal of crop management in urban small space environments, and have spread it to households in provinces and cities in Vietnam, to provide a source of fruit, Reliable clean vegetables serve the needs of households, saving a huge daily cost. This is a very good trend, suitable for the conditions of urban people, improving the economy and bringing health to everyone. On the other hand, the green area on the roof also brings fresh air, contributing to minimizing climate change in the present and future (Fig 6).

Acknowledgements

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