MICROCONTROLLER-BASED EMBEDDED SYSTEM DESIGN AND IMPLEMENTATION TOWARDS SUSTAINABLE DEVELOPMENT GOALS

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The United Nations approved the 17 Agenda of the Sustainable Development Goals (SDG) to implement a sustainable world by 2030 [1]. It was accepted that poverty and other problems in this world must be resolved jointly in the areas of poverty, health, energy, education, gender inequality, economic growth, environment and climate changes, social issues, collection and preservation of natural resources above and below this earth, etc. [1] The 17 SDGs encompass 169 sub-targets to be attained by 2030 [1]. For this purpose, we need a coordinated and concerted efforts by all signatory countries. Engineering design research, innovations, development, and commercialization can support us in the venture.

In this talk, emphasis would be given to the recent research and innovative product development to the microcontroller-based embedded system design to realize the 17 SDGs within the stipulated time frame, and as such, we will be able to attain both societal and economic impacts for viable progress.

The word "embed" means "To fix (an object) firmly and deeply in a surrounding mass." It means that the system is portion of a bigger device or system. Embedded would also mean connected with something for some purpose and with limited resources. An embedded system serves a specific purpose and the functionality of that purpose is executed and controlled by a miniature controller, which is embedded within the system. For example, a microcontroller can be a heart of an embedded system. We may use Arduino Uno. Arduino Mega, Raspberry Pi, or STM microcontrollers to design embedded system based on our system requirements and specifications [2-4].

An embedded system has a set of following characteristics, such as:
• An embedded system is a kind of mini computer;
• It forms part of a bigger system, device, or machine;
• It can control multiple devices through its I/O ports;
• It may receive signals from multiple sources through various sensors connected to its I/O ports;
• It can allow its users to interact with it through its I/O ports;
• It has one, or a limited number of tasks that it should accomplish.

An embedded system is preferred due to its several advantages, such as:
• Perform only very specific and restricted number of functions;
• Comparatively cheaper to design and implement;
• Necessitate less power to control;
• Systems may run by using batteries;
• Does not require much processing speed;
• Possible to build it using cheaper, less powerful processors to minimize the costs.

Here, I shall also concentrate on a few goals to demonstrate how the microcontroller-based embedded system design and development can help us in this regard. These areas are good health and well-being, quality education, clean water and sanitation, affordable and clean energy, sustainable cities and communities, life below water, and life on land [1]. We started our research works on microcontroller-based embedded system design by designing and implementing biomedical devices, like IoT-based pulse oximeter device, designing a device to measure the activity level of the body, especially in measuring the amount and quality of sleep by a person in his house and thus to improve his home's heat consumption or temperature, blood pressure measurement, glucose level measurement, microcontroller-based ECG machine design, etc. to attain the goal of good health and well being [3-6]. We also started our works on IoT-based student database preparation for calculating students' outcomes for courses and programs of study by implementing outcome-based education (OBE) system to attain the goals for quality education using both online and on-campus mode of education [7-9]. We also worked on designing, simulating, implementing, and testing of a solar power and an IoT-based pisciculture management system to attain the goal on life below water [10]. We are also working on an IoT based eco-friendly efficient cattle management system, an IoT based smart robot car for hazardous areas with live streaming option, an IoT-based bio latrine system design and implementation for achieving the goal of life on land [11].

Finally, we are confident that the microcontroller-based embedded system design is very chip and so, electronic engineers find it easy to resolve complex engineering problems to achieve specific SDGs, and hence to realize a sustainable world for humanity.

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