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An IoT Based Sustainable Automation system for the Garments industry in Bangladesh

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Abstract

The readymade garments sector accelerates Bangladesh's development. The "Made in Bangladesh" brand has also helped to boost Bangladesh's reputation and brand recognition on a global scale. Despite its limited resources, the country has maintained a 6% annual GDP growth rate while attaining extraordinary social and human development. On the other hand, the phrase "Internet of Things" (IoT) refers to a broad concept summarised as an ecosystem of intelligent gadgets equipped with networks, sensors, and processing tools. IoT is a new technological platform that enables the many objects in our environment to connect via sensors and the internet to improve our quality of life. Manufacturing and the industrial sector, agriculture, the health sector, smart cities, security, and emergency services, to name a few. IoT implementation in the garment sector would open a new door to growth in production and worker safety. Implementing home automation and safety systems in the garment sector will help in production and ensure the safety of the workers. The suggested IoT-based sustainable automation system for the Bangladeshi garments sector is efficient, eco-friendly, secure, reliable, and user-friendly. The system's user-friendly interface makes it straightforward to use and manage. The Bangladeshi garments industry's IoT-based sustainable automation system is a comprehensive and integrated solution that addresses the industry's primary difficulties and provides a sustainable and viable future.

Keywords: *Bangladesh, Garments, Sustainable, IoT, Production, Implementation, Safety.*

1 Introduction

Bangladesh's readymade garment industry (RMG) accounts for around 83% of the country's overall export volume (Ahmed and Hossain, 2021). Bangladesh's garment sector has grown steadily in recent decades, making it the world's second biggest behind China. In the previous fiscal year, the government exported RMG valued at $42 billion. The Association of Bangladesh Garment Manufacturers and Exporters (BGMEA) has set a target of $100 billion in exports by 2030. Global firms are preparing for the fourth industrial revolution. 4.0 Industry. It is the idea of converting a complete manufacturing facility into an IoT (Internet of Things)-based factory. IoT is gaining popularity in the textile and apparel sectors to increase process efficiency. Bangladesh's textile sector has indeed begun to transition to Industry 4.0. Bangladesh has used the Internet of Things (IoT) with RFID-based monitoring systems in the garment manufacturing process to boost productivity and minimise production costs in the textile and garment industries. The Internet of Things (IoT) is a network of interconnected computing devices, mechanical and digital machinery, items, animals, or people that have unique IDs and the ability to send data over a network without requiring human-to-human or human-to-computer interaction. In terms of employment and foreign exchange revenues, the readymade garments (RMG) industry has the most significant potential of any other sector to combat poverty and strengthen the national economy. Along with its promise, the industry is also facing new difficulties that might determine whether it can remain viable. The current study uses descriptive research to identify the many issues confronting Bangladesh's readymade garments business and provide workable solutions.

This sector also faces many challenges, like an electrical energy shortage—intelligent automation systems, water wastages in production etc. To overcome these challenges, we must take numerous collaboratives and coordinated steps from owners and significant stakeholders to achieve the top position in the world apparel market. The main objective of this Recherche work is to develop a sustainable IoT-based automated door open-close, garment light control to reduce wastages of electricity, ensure innovative water supply to ensure interrupt less water to production, fire detection and alarm to awareness of fire disaster, and automatic collection of solar and electricity for effective utilization of solar energy.

2 Literature Review

Garments automation aims to provide the framework for the RMG sector to leverage cutting-edge technologies such as big data, the cloud, and the Internet of Things (IoT) for automating, tracking, monitoring analyzing operations. To increase RMG productivity in terms of quality and quantity, the researchers have worked on several projects.

Lack of water scarcity is a significant concern (Vivek et al., 2014). Automatic water tank control is made possible by installing ultrasonic sensors—authors of some projects, like (Kekre and Gawre, 2017), created and implemented an automation system. The ultrasonic sensor in this system measures distance and assesses any potential differences in tank water levels. A relay connects the microcontroller to the pump that fills the water tank if the potential difference is less than the value.

A visitor counter and an automatic room light controller are combined in this Research. A microcontroller is used in a dedicated circuit that precisely counts the number of people/visitors in the room while also managing the lights in the space. The counter is increased by one, and the sunlight is switched on when someone enters the room. When someone leaves, the counter is decreased by one. The light will be switched off once everyone has left the room, proposed in ("Industrial Automation," n.d.).

3 Proposed Methodology

This research aims to create an IoT-based automated room light control, bright door, intelligent water supply, smart solar and electricity supply, and innovative fire detection system for the garments industry ("Industrial Automation," n.d.). The plan uses different types of sensors for input to collect data from a different perspective. And the various output devices that apply the necessary action after processing the data collected from the other sensors.

- Firstly, the automated room light control is based on the interfacing ultrasonic sensor value to count in both directions. The system calculates the number of people passing through an entrance gate to a room and the number of people exiting the space by reducing the count. When there are more people present than one, the room light is turned on, and when there are fewer people there, the room light is turned off.
- Second, the automatic door open-close system is based on the PIR sensor. When the PIR sensor sensors detect any motion near the door, It will transmit a signal to the microcontroller, sending a password to the motor to open the door. If no person motions near the door, it will close after some delay.
- Third, the Fire Detection system will work based on the MQ-2 gas sensor and Flame sensor. A photodiode detects light and an op-amp monitors the sensitivity of the flame sensor module. It is used to detect fires and emits a HIGH signal. When the Arduino detects the Signal, it activates the buzzer and LED. The flame sensor used is an IR flame sensor. An electrochemical sensor in the MQ 2 sensor adjusts its resistance to different flammable gas concentrations. The sensor is wired to a voltage divider circuit in series with a variable resistor, and the variable resistor is used to adjust the sensitivity. When combustible gaseous constituents come into touch with the sensor, it is heated. The sensor's resistance changes as a result. A microprocessor can read the voltage across the sensor when the resistance changes. In this case, Arduino reads the value and activates the buzzer and Light.
- Fourth, the water level in the tank is continuously monitored by the ultrasonic sensor positioned on top. When the tank's water level falls below 20%, the pump activates via the relay mechanism and remains on until the tank is full. The pump is subsequently switched off, and the loop is iterated again.
- Finally, the automatic solar and electricity supply system worked based on the LDR sensor, Current sensor, and Voltage sensor. The system will automatically change solar power to electricity based on sensor data.

3.1 Main Components Used in This Study

Arduino Uno R3

The Arduino Board Figure 1. is based on the Microchip ATmega328P (Ahmed and Hossain, 2021). Arduino's analog input/output pins can link to other boards and circuits. Boards link devices.

Figure 1. Arduino Uno R3

Servo Motor

A Servo motor shown in Figure 2. is commonly used in automation technologies (Ahmed and Hossain, 2021). It has an independent mechanism that swiftly and accurately spins machine components. We have used it to open and close the door.

Figure 2. Servo Motor

Ultrasonic Sensor

Figure 3. shows that a sonar sensor, also known as an ultrasonic sensor, has been used for decades and Measuring distance. It works by measuring an object's distance by employing ultrasonic sound waves. An ultrasonic sensor uses a transducer to transmit and receive ultrasonic pulses that convey messages or information about the presence or proximity of an object.

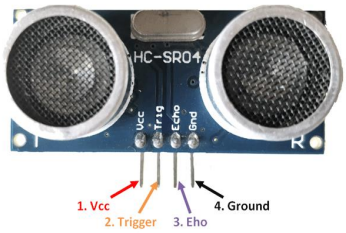

Figure 3. Ultrasonic Sensor

PIR Sensor

PIR is an abbreviation for Pyroelectric Infrared Radial Sensor, sometimes called a Sensor for Passive Infrared. PIR is an electronic sensor that responds to changes in infrared light over a specific distance by emitting an electrical signal. It can recognize any infrared-emitting object, including people and animals, whether nearby, moving out from the sensor's range, or entering it. Figure 4. Shows the PIR motion sensor.

MQ-2 Gas Sensor

The MQ-2 is shown in Figure 5. The type of smoke sensor is composed of tin dioxide semiconductor gas sensing material. When it operates at temperatures ranging from 200 to 300 °C, the tin dioxide adsorbs the oxygen in the air, reducing the density of electrons on the semiconductor and therefore increasing resistance.

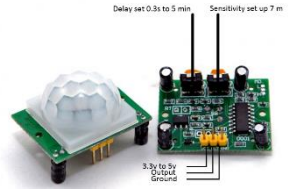

Figure 4. PIR Sensor

Figure 5. MQ-2 Gas Sensor

LDR Senosor

Figure 6 indicates that Light Dependent Resistors, the complete form of LDR, automatically detect light levels in security lighting. Their resistance declines as the light intensity rises in the dark and at low light levels; an LDR's resistance level is referred to as high and can pass through a tiny current.

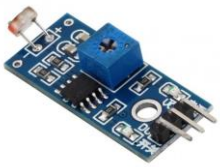

Figure 6. LDR Sensor Module

Water Pump

Water pumps shown in Figure 7 move water from a lower to a higher level, flowing through channels to the tank that needs a refill.

Figure 7. Water Pump

4 Working Procedure and Result

The microcontroller will seek the room light control Sensor Exit if sensor Entry is first interfered with. The microcontroller will raise the count if it is disturbed. The counter starts over at one, and the LIGHT goes ON when the first person enters the room. Sensor Entry will be sought if the sensor Exit is first interrupted. The

microcontroller decreases the count if it is interrupted. The countdown resets to zero, and the LIGHT goes OFF as soon as the last individual leaves the room.

PIR sensor and automatic door opener have a very straightforward mechanism. This study uses an Arduino Uno and a servo motor to upgrade the automated door-opening system for clothing. The Data OUT Pin turns HIGH when the PIR Sensor detects a human motion. This pin's connection to the Arduino allows it to determine when a person is approaching the door by detecting the HIGH Signal. The door is then opened right away by Arduino by turning on the Servo Motor. The Arduino will restart the Servo Motor to close the door after a brief interval (about 2 to 5 seconds in our example).

The Ultrasonic Sensor Module utilized in this Project's simple operation emits sound waves into the water tank while simultaneously detecting the sound waves' reflections or ECHO. Using an Arduino, we must first trigger the ultrasonic sensor module to broadcast a signal before waiting for the ECHO to arrive. Arduino measures the interval between a trigger and ECHO signal reception. Since we are aware that sound travels at a speed of about 340 m/s, we can use the following formula to determine distance:

Distance= (travel time/2) * speed of sound

In this case, the speed of sound is roughly 340 meters per second. These techniques allow us to determine the sensor's distance from the water's surface. We then need to choose the water level. When the water level is below 20%, it turns on the water pump, and when the water tank is complete, it turns off the water pump using a Signal from Arduino Uno.

The cornerstone of a fire sensor system has been demonstrated and involves the simultaneous monitoring of CO, CO2, and smoke concentrations. Because of its early fire detection capability, quick response time, and inexpensive cost, a fire detector is widely utilized as a smoke sensor. The implanted Arduino board, programmed in Android Studio, receives signals from sensors that, among other things, measure temperature, humidity, gas, and smoke levels. The sensor must be connected to the Arduino's input using connection wires or jumper cables. The buzzer is connected to the output further along in the circuit. The buzzer's tone also changes as the delay value is altered. This makes it feasible to detect various gases. Arduino was specifically chosen for this design because it is easy to use in a circuit and upload applications. The implanted Arduino board written in Android Studio gets signals from sensors that measure temperature, humidity, gas, and smoke levels, among other things. The sensor must be connected to the Arduino's input using connection wires or jumper cables. The buzzer is connected to the output further along in the circuit. The buzzer's tone also changes as the delay value is altered. This makes it feasible to detect various gases. Arduino was specifically chosen for this design because it is easy to use in a circuit and upload applications.The power supply system work by following steps:

Step 1: LDR When a sensor detects daylight, Arduino sends a signal to a switching mechanism to change the power system's solar energy to electrical energy.

Step 2: The current sensor detects the current label when the current label is below a specific label; then, the Arduino sends a signal to the switching device to alternate solar energy to electricity.

Step 3: If the LDR and current sensor detect the day and current value to a specified label, the Arduino sends a signal to a switching device to switch between solar energy and electricity when the current label is below a given label, which the current sensor detects.

5 Conclusion

The garment industry will be significantly impacted by the Internet of Things (IoT). According to a TechParker analysis Segura,A.(2018), businesses and designers are embracing IoT technology to push the limits of marketing and manufacturing. Colorful clothing, wearable environments, versatile designs, and responsive sports have all grown significantly recently and have promising futures. Due to the increased adoption of the Internet of Things, many companies have started producing apparel with digital capabilities (IoT). IoT is among the most amazing and important tools for the healthcare industry, not simply the garment industry. It will provide patients, healthcare professionals, and researchers with a variety of options in state-of-the-art healthcare facilities. It is possible to do away with the necessity for an external 5-volt and 3.3-volt power supply by using only the electricity generated by the solar panel. Power generation can be enhanced by using a motor and control system to follow the sun. By utilizing various machine learning techniques and models, it is also possible to develop systems intelligent enough

to make decisions on data and performance. The intelligent room light management system makes judgments based on whether or not people are present. But, for better system performance in this instance, we may also link the PIR sensor and LDR (Light Dependent Resistor). This system can also be linked to a Bluetooth module, making it possible to control the complete setup with just one click from a mobile device.
Sustainable automation can reduce environmental impact, improve global competitiveness, and assist Bangladesh's textile industry in meeting international sustainability criteria. Without endangering the environment or workers, the proposed technique can also lower industry costs. In conclusion, an IoT-based sustainable automation solution for the garment sector in Bangladesh might revolutionize and sustain growth. The sector can combine automation and sustainability to achieve both economic growth and environmental conservation.

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