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# DATA ACQUISITION AND ALERT SYSTEM USING BLYNK PLATFORM

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**Abstract -** *The term Industry 4.0 stands for the fourth industrial revolution which is defined as a new level of organization and control over the entire value chain of the life cycle of products. This paper presents a new approach for Data acquisition and Alert systems to facilitate industry 4.0. The paper proposes a system that comprises of Node MCU development kit interfaced with physical sensors which provide information to communicate within the network of machines. C programming is used to program the microcontroller and the data produced is then analyzed on an IoT platform. IoT platform plays a vital role in quickly analyzing huge amounts of machine data and making quick decisions in real-time.*

***Key Words***: **Data acquisition system (DAS), Thermocouple, Proximity sensor, Node MCU, IoT, Blynk**

## 1. INTRODUCTION

Industrial Internet of Things or IIoT is a technology that deals with bringing control of physical devices over the internet. The automation system allows users to efficiently control industrial machines over the internet. Acquiring machine data plays a vital role in increasing the efficiency of production in any industry. All industries in the fourth revolution are driven by data. Every machine on a production line or an assembly line is now controlled with no or minimal human intervention. It is only logical that their output is tapped wireless using a data acquisition system. Data acquisition system refers to the collection of machine data in digital form as accurately, rapidly, and economically as necessary. This paper describes Data Acquisition and Alert system. Data is collected from sensors and actuators. Apart from sensors, DAS includes communication links, signal processors, computers, databases, data acquisition software, etc. These systems are generally used to collect data from the sensors and take corrective measures. Reports generated after collecting the data help us to study how the data is varying and to make preventive decisions based on that which is carried out with the help of the IoT platform "Blynk".

## 2. LITERATURE SURVEY

The scope for digital information has gained huge importance as the use of the internet in day-to-day applications grows every day. With the aid of internet-based information technology, the process of data acquisition, computation, and delivery of information can be completely automatic. DAS (Data acquisition system) refers to the collection of software and hardware that allows us to measure physical parameters in real-time. The main process involves sampling the signals that convert the analog value of the sensors installed to a digital value that computers can manipulate. To initiate collecting data from sensors, a microcontroller with the ability to connect to a wireless network is needed. The concept of Internet of Things (IoT) is used as the framework to develop an integrated information system that can carry out this entire process. The proposed project makes use of a thermocouple sensor and proximity sensors which are mounted on an extruder machine to collect machine data. An extruder machine produces continuous lengths of plastic sections out of a selected ratio of plastic resin. (Extrusion Process is a semi-continuous or continuous process that can be done with hot or cold material. Common materials which can be extruded are ceramics, polymers, metals, concrete, and foodstuff).

Proximity sensors detect a metallic object that causes a disruption in the electromagnetic field emanating from the body of the sensor. As the sensor comes in contact with a metal piece attached to annealing rollers, it detects the presence of the electromagnetic field and detects the presence of metal. Inductive Proximity Sensors work on the principle of detection of magnetic loss due to eddy currents that are produced on a conductive surface by an external magnetic field. A magnetic field is generated on the detection coil, and any changes in the impedance due to the development of eddy currents generated on a metallic object are detected and values are returned. They are very reliable and have a high switching rate which ensures a longer service life. The paper aims to present the application of an inductive proximity sensor in a polymer industry to calculate the production per hour and the line speed of the rollers. This helps in identifying the problem areas. The sensing range of inductive proximity is around 1mm-5mm. The authors Christoph Kluser b and Roger Bischofberger Reference [1] describe various parameters that affect the output of proximity sensors such as temperature variations. Temperature variation in the range of 100 degrees influences the output of the proximity sensor. Because proximity sensor works on the principle of magnetic field and magnetic fields are influenced by temperature. To overcome this temperature variation, the principle of fully integrated temperature compensation can be used. It is a method of correcting an undesired influence of temperature. Ideally, the temperature compensation method will eliminate all effects of a change in temperature on the measured value delivered by a sensor.

In this project, an IIOT system is implemented to monitor sensor data using the mobile/web-based platform named Blynk, which is integrated with the Node MCU micro-controller device. By validating the results of implementation and testing, the concept of data acquisition and data alerting can work well where temperature and rpm (rotations per minute) data can be obtained and processed automatically in real-time when connected to the internet. Using the BLYNK application, one can aggregate, visualize and analyze live data streams on the cloud. Blynk is a platform with the flexibility to run many hardware modules like Arduino, Node MCU, Raspberry Pi, etc. Blynk application is supported on both Android and IOS devices. The sustained choice of connection between the micro-controller is Wi-Fi, cellular network, or Ethernet. Once a connection has been established using any of the modes mentioned before, all the data can be viewed on the Blynk application.

## 3. METHODOLOGY

The Block diagram in figure 1 explains the proposed method. There are five main units in the proposed system. They are Power Module, Sensing Unit, Node MCU, IoT Platform, and MQTT. The power module is used to power the entire system. The project uses SMPS (switching mode power supply) which contains AC to DC converter, transformer, and bridge rectifier to get linear steady-state output voltage. The sensing unit contains multiple sensors to sense temperature and rotations. Two K-Type thermocouple sensors and an inductive proximity sensor are mounted on the extruder machine. The output of the sensing unit is sent to the microcontroller development board for signal processing and data visualization. Node MCU is a development board consisting of an ESP8266 micro-controller Wi-Fi-enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems. It collects the signal data from the sensors and processes them as programmed. Once signal processing is complete, the data is sent to the IoT platform to store and visualize it. Node MCU triggers an alert when certain values are received from the sensors, these values are an indication of important information about the machinery that requires immediate attention. MQTT is a messaging protocol that is used to send alerts. MQTT is a lightweight subscriber messaging protocol designed for applications in low-bandwidth, high latency, unreliable networks. MQTT's features make it an excellent option for sending high volumes of sensor messages to analytics platforms and cloud solutions.

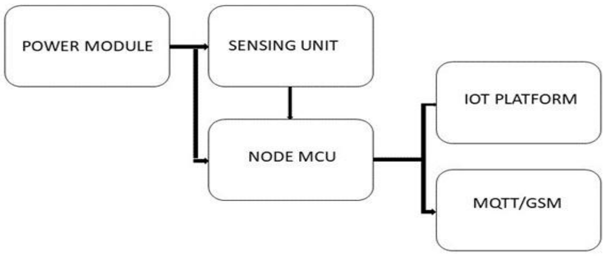


**Fig -1**: Block Diagram

## 4. SOFTWARE IMPLEMENTATION

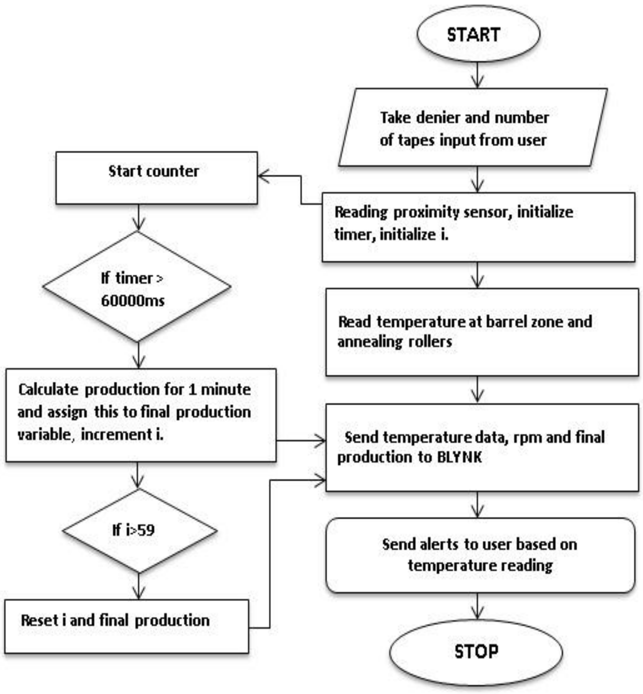


**Fig -2**: Flowchart

The flowchart begins with taking the inputs from the user (denier and number of tapes) and initializing a variable "i" to 0. The microcontroller then reads the values from the proximity and temperature sensor. The code flows further to start the timer followed by a counter. Every time the proximity sensor detects the target the counter is incremented. If the timer exceeds 60000 ms the production per minute is calculated using a counter value and a formula that is designed to calculate production. This is added to the variable "final production" every minute. The variable "i" is incremented and the counter is reset. If variable "i" exceeds 59, "i" is reset to 0, final production is sent to the BLYNK platform and then final production is reset. Similarly, the microcontroller reads temperature at the barrel zone and annealing rollers with the help of a thermocouple. Temperature data is sent to BLYNK. Blynk is used to send alerts in the form of push notifications and SMS based on trigger conditions when the machine reaches non-optimum temperature conditions.

## 5. EXPERIMENTAL DETAILS

The areas of interest in the machinery for this experimentation are the heating barrel zones and the annealing rollers placed at the initial and end unit of the extruder machine respectively. Solid raw materials are poured in a predefined ratio into the heating barrel zones, a thermocouple is placed in the barrel zones to monitor the temperature required to turn the solid raw materials into a liquid state. Variation of temperature in the heating coils of the barrel zone greatly affects the quality of polymers produced. It is a conventional practice to attain the optimal temperature by preheating the barrels and then allowing the inflow of raw materials. Having a 6' K-type thermocouple installed at this unit allows constant monitoring of temperature directly from the Blynk cloud platform. Having an additional add-on installed to this platform provided the scope to send important alerts informing about important temperature data. Similarly, a second thermocouple is installed at the annealing rollers present at the end unit, the polymers are stretched due to the constant tension provided by continuously rotating on the rollers. The rollers are filled with hot oil which aids the stretching of the fibers of the polymer. It is of foremost importance that the temperature is uniformly maintained in these rollers, thus a 12' thermocouple was placed to observe the oil temperature inside these rollers. The setup continuously monitors the above-said parameters and collects all the production data automatically. Data collected can be viewed and analyzed at any given point, this gives a great opportunity for the industry to understand the areas in which they can improve.

Figure 3 depicts the temperature vs time graph. The temperature varies according to the temperature of the barrel zone. As seen in the figure, from time 5:00 pm to 5:11 pm the temperatures are varied only plus or minus 2 degrees, this tells us that there is not much variation in temperatures at both the barrel zone and annealing rollers of the extruder machine. But when this temperature exceeds the operating range, an alert is sent to the client.

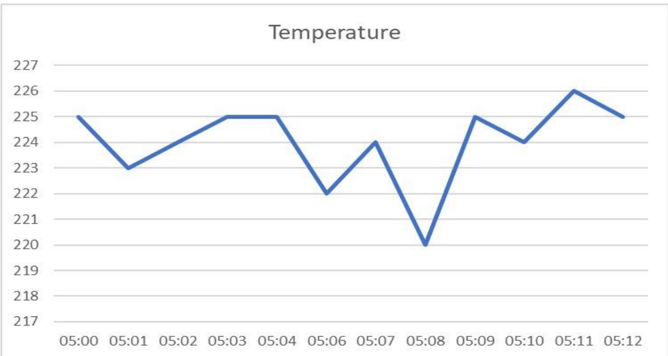


**Fig -3**: Temperature graph

## 6. HARDWARE DESIGN

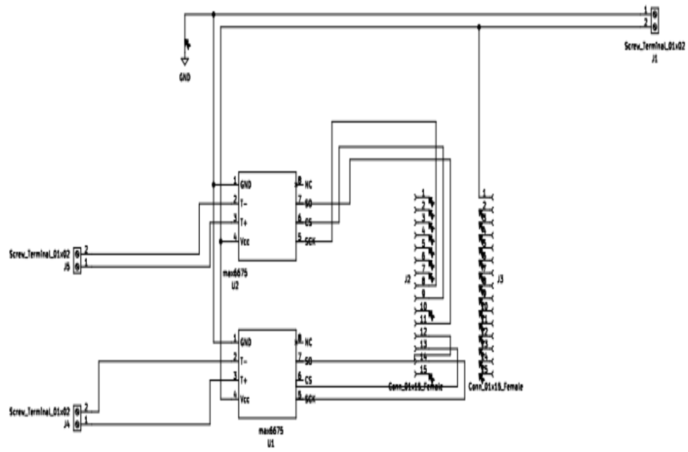

**Fig -4**: Schematic of PCB Design

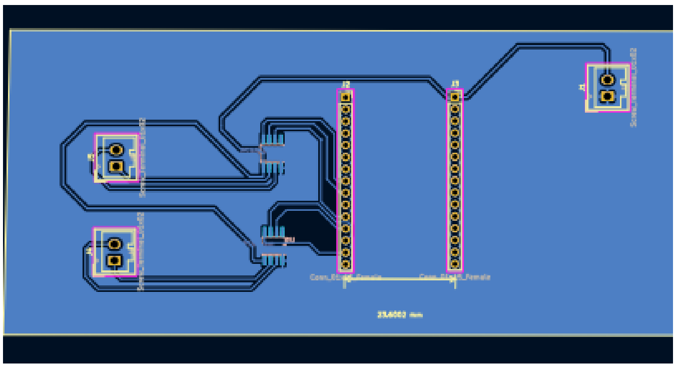

**Fig -5**: PCB Design

PCB designing is one more segment of the project. A printed circuit board design brings all the electronic components together used in the implementation of the project. A PCB design was chosen to eliminate the point-to-point wiring and prevent short circuits. It can be designed in a way to mechanically support and electrically connect all the components. When no active devices such as capacitors and resistors are included on the board and the board consists only of copper tracks and features manufactured on the substrate board, it is referred to as a Printed Wiring Board (PWB). For designing the PCB, KiCAD software is used. The PCB design feature with Node MCU microcontroller incorporates the MAX6675 modules with two thermocouples. An OLED display is included to display the value of temperature and if this value is higher than a set limit, an alert is sent to the factory worker to switch off the machine. As mentioned in section 4, this is done using the BLYNK platform.

## 7. RESULTS AND GRAPHS

**Table -1:** Relationship between RPM and Production per minute

| Timestamp (pm) | RPM | Production per minute (in Kg) |
|---|---|---|
| 5:00 | 193 | |
| 5:01 | 197 | 2.34 |
| 5:02 | 200 | 2.38 |
| 5:03 | 220 | 2.62 |
| 5:04 | 220 | 2.62 |
| 5:05 | 220 | 2.62 |
| 5:06 | 220 | 2.62 |
| 5:07 | 219 | 2.60 |
| 5:08 | 220 | 2.62 |
| 5:09 | 220 | 2.62 |
| 5:10 | 220 | 2.62 |
| 5:11 | 222 | |

Table 1 describes the relationship between the rotations per minute (rpm) of the annealing rollers and the production per minute. The rpm is varied by the operators in the company according to the physical parameters of the raw materials used for production and this value will not be constant throughout, hence rpm is calculated constantly. Production per minute is calculated according to changes in rpm, this production per minute for one hour is added up which gives production per hour. In the above graph, the timestamp taken is from 5:00 pm to 5:11 pm, to calculate the production per minute for a period of 10 minutes. The production per minute remains constant throughout. This is collected for one hour and added up to get production per hour.

A beta test was conducted on the plant. The graphs in Figures 6 and 7 describe the accuracy of the DAS system when compared to the manual calculation system. The pie chart depicts the net production including the wastage as calculated manually and from the data acquisition system. The orange portion of the pie chart depicts the net production and the blue portion indicates the total wastage as calculated from the factory.


**Fig 6:** RPM Graph (Rotations per Minute)

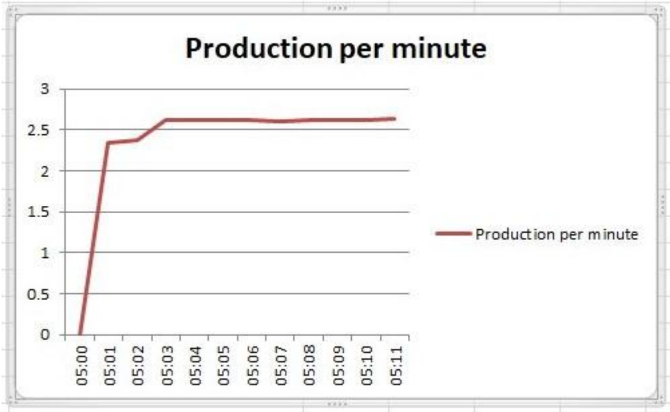


**Fig 7**: Production per minute

It is seen that the data acquisition system (DAS) has an accuracy of 98 percent with a total production of 1527 kg when calculated for 9 hours and 36 minutes. The beta test is successful in determining the production per hour and the Data Acquisition System (DAS) will be an effective way to calculate the production daily instead of manually calculating the production per hour values and the total production. The project aims to automate this section of calculating the net production.

Another objective of the project is to send alerts to the factory worker when an optimum temperature is reached. Using the BLYNK event section a push notification/ SMS (short message service) can be sent to the worker alerting him with a custom message.

The figure 6 shows the output of the temperature sensor. The thermocouple placed in the annealing rollers shows a temperature of 187.75 degrees. If the temperature reaches above 250 degrees, push notification or an SMS is sent to the factory worker.


**Fig 8**: BLYNK dashboard

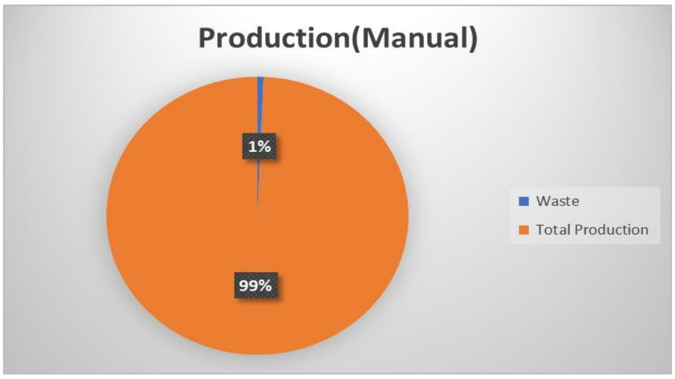


**Fig 9**: Production (manual)

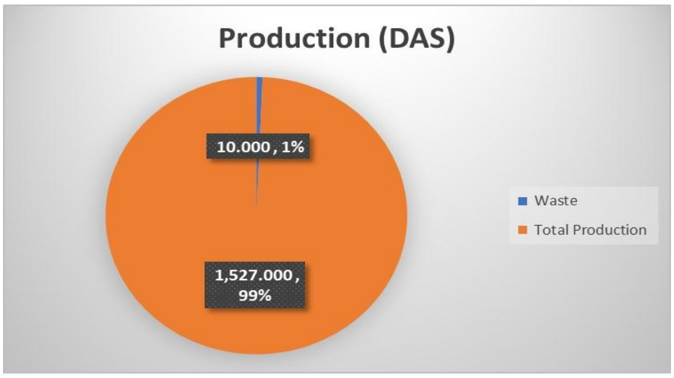


**Fig 10**: Production (DAS)

## 8. CONCLUSIONS

The Data Acquisition system using the Blynk platform is successfully implemented on the extruder machine. DAS captures the rotation count of rollers and also the temperatures at two different locations. The count along with other parameters like denier and number of tapes when applied to the industry formula gives us the production. Temperature sensors along with the BLYNK platform alert the client if the optimum temperature exceeds the limit so they can take necessary corrective measures.

The system stores and analyses the data. It also serves the purpose of real-time data plotting that helps analyze production and take precautionary measures.

The errors in the measurements are avoided as there is no human intervention. The system is cost-effective with a good amount of accuracy.

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