A STUDY ON AUTOMATED TOOL WEAR MONITORING BY USING IOT

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Abstract: Nowadays we live in a world, which a decade ago would only be described in the science fiction literature. More and more things become smart and both scientists and engineers strive for developing not only new and innovative devices, but also homes, factories, or even cities. This project reviews the usage of adjective smart in respect to technology and with a special emphasis on the smart factory concept placement among contemporary studies. Due to a lack of a consensus of common understanding of this term, a unified definition is proposed. The conceptualization will not only refer to various smart factory visions reported in the literature, but also link the crucial characteristics of this emerging manufacturing concept to usual manufacturing practice.

Keywords- IOT, WI-FI module, Arduino, current sensor, storage, control board, mechanical setup.

1. Introduction

A building or a group of building where goods are manufactured or assembled chiefly by machine on mass scale with the help of individual craft man. Using a good factory system we can get a new product out faster to your perspective customer on time. A factory system can speed up the overall process of creating producing our new product for our customer. Factory mainly depends upon the productivity only. The productivity gives an idea to the manufacturing and the productivity plays a vital role on the life of productivity. Productivity mainly explain the economic status of factory. Factory requires an inputs as in the form of raw material and workers work which is the main sources of the factory then these will be turned to the required and finished good quality product by various machining process with the help of various worker on different department work with the same goal.

2. Methodology

The project work has been carried out as in the following methods.

Step: 1 Indendifying The Project,
Step: 2 Collecting The Existing Data,
Step: 3 Analysing The Information & Collection Of Datas For Present Work ,
Step: 4 Purchasing The Project Components,
Step: 5 Programing The Project Components (Wi-Fi Module, Arduino Controller),
Step: 6 Assemble The Project Components Together And Create A Prototype,
Step: 7 Run The Project And Collecting The Machining Datas,
Step: 8 Monitoring The Machining Tool Datas Using Current Sensor & Report Send To Respective Authority.

3. Experimental Procedure

3.1 Controlling The Machine Using Iot

![Figure 1. Iot Processing Diagram]
Normally the machines are controlled using the direct contact only. But in normal contact the operator has to touch the touchpad or teach pendant in CNC or any machine and each operator is required to operate each machine. To overcome this problem we can control one or many more machines in same time using IOT. The IOT is basically a communication system which can transfer the data from one to another in mille seconds, this is used in industries for getting the exact status and movement of the AGV’s but this system can be used for the controlling also. In our system there is an accesses point (AP) which will act as a receiver an also data transmitter and ESP is connected with the machine and as well as to controlling device.

The data given from the controlling system will be converted into binary codes by ARDUINO controller, then the data is passed to the ESP which will send the data to machine in wireless medium, where in machine the data receiver will collect the data. The data is passed to relays and stepper motor which the electrical plusses are converted into mechanical movement which will operate the machine according to the requirement or setup.

3.2 Iot Process

IOT (INTERNET OF THINGS) is basically a communication system which can transfer the data from one to another in mille seconds. It is simple concept wherein machines and daily objects are connected and monitor remotely. Within the IoT, devices are controlled and monitored remotely and usually wirelessly. Wi-fi connected bees are now in development to help with pollination. By using IOT, machine is fully controlled and also processing data, device’s status and processing time are gathered. Here micro controller, current sensor and wi-fi module are acting as IOT. In this process feed motor, drill motor and its power drives are connected with micro controller. Micro controller is connected with wi-fi module. This wi-fi module is connected with cloud storage wirelessly.

4. Tool Wear And Breakage Monitoring System

The tool wear and tear will decide the quality of the job which is produced by that tool. In our project the tool wear and tear can be analyzed by our motor voltage. Where every motor will increases the voltage inlet amount when the load is applied and parallel the speed of the tool is decreases in that stage the current value also changed, by using the current sensor the current is measured. In current sensor an analog value is generated for the current passed through the sensor. When the deflection in the analog value the current is in varying condition. When the analogue value suddenly decreased till minimum value the tool is breaked and the machine will come back to the origin position. While in tool wear and tear the analogue value is varied step by step, which be increased from minimum to maximum, when the maximum value is reached tool is totally affected by wear and tear which requires reconditioning or otherwise the tool for the machine has to be changed.

5. Making The Machine To Set Its Own Reference Point

In normal the machine is directly controlled by the human the human can think and set the starting point of the job for the accuracy. In CNC’s the programmer will analysis the job and set program for the specific job which will correctly work the program but when the material dimension is changed the program also would be changed. This take a long period of time to write a program to CNC’s this is a main drawback on the current using method. When the machine is remotely operated the human cannot see the reference point and handle in the direct contact which will consume some time while in mass production. We rectify this by using a current sensor, the current sensor will receive the current and give an analog value for the same current value. While drill setup is moved from top to bottom, while the material is detected the sudden increases in the current sensor value and the job processes is started after the target is archived or reached the setup will come back to the origin point.

6. Experimental Setup

6.1 Prototype Setup

Prototype is an early sample, model, or release of a product built to test a concept or process or to act as a thing to be replicated or learned from. A first or preliminary version of a device from which other forms are developed. A Visual Prototype represents the size and appearance, but not the functionality, of the intended design. The materials that will be used in a final product may be expensive or difficult to fabricate, so prototypes may be made from different materials than the final product.
Mechanical setup is main part of this process. It is the body of the whole setup. It have one base plate, guide way and lever for holding drilling motor. Base plate is holding whole parts. Guide way was fixed permanently in the base plate. Guide way have a thread rod inside itself. It’s used to move the drill motor’s supported lever by threads. Thread rod is fixed inside the guide way by bearing.

6.3. Controller Setup

controller setup is the main part of this whole process. It’s act like brain of the machine. It’s control the whole process of the machine and also monitoring the machine’s processes. Controller setup processing diagram was shown above, In this processing diagram Arduino act like main controller. It is connecting three ways of flow together.

In this Arduino, it have two type of input/output pins ‘digital and analog pin’. Feed motor and it’s four channel relay are connected in digital input pins. Drill motor, current sensor and drill motor relay are connected in analog pins. In this control board it’s have two wi-fi modules and it’s connected in digital pins. Wi-fi modules are used for transfer and receiving the data from machine to cloud and also cloud to machine.

7. Results And Discussion

The following datas are taken by running the prototype. And the values are tabulated below. The values are taken from different tools and workpieces.

7.1 Result Tabulation
Table 1:

<table>
<thead>
<tr>
<th>S.N</th>
<th>MATERIAL</th>
<th>LOAD CONDITION</th>
<th>SPEED (RPM)</th>
<th>CURRENT (mAmps)</th>
<th>VOLTAGE (volts)</th>
<th>HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>TEAK</td>
<td>NO LOAD</td>
<td>2000</td>
<td>200</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEW TOOL</td>
<td>1500</td>
<td>400</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OLD TOOL</td>
<td>1300</td>
<td>650</td>
<td>12</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>SANDAL WOOD</td>
<td>NO LOAD</td>
<td>2000</td>
<td>150</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEW TOOL</td>
<td>1700</td>
<td>300</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OLD TOOL</td>
<td>1450</td>
<td>550</td>
<td>12</td>
<td>100</td>
</tr>
<tr>
<td>3.</td>
<td>COUNTRY WOOD</td>
<td>NO LOAD</td>
<td>2000</td>
<td>150</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEW TOOL</td>
<td>1800</td>
<td>225</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OLD TOOL</td>
<td>1450</td>
<td>350</td>
<td>12</td>
<td>100</td>
</tr>
</tbody>
</table>

9.3 Graphical Representation

Following graphs are drawn by the values taken from the table. The below graphs were drawn for motor’s spindle speed and motor current values. Speed values are put in X axis and motor current values are put on Y axis. This graphical values are drawn for know the variation between motor current and speed. When the motor speed was varied current value also varying.

9.3.1 Graph For Teak Wood

The following graph is drawn for the motor’s speed and current values.

![Graph For Teak Wood](image_url)
The above graph is showing the current and speed values of motor. When the motor current value was increased motor speed was getting low. When the motor speed is 2000RPM current of the motor is 200mAmmps. After the load was given motor’s current value gets 400mAmps. Continues of load acting motor’s speed get low to 1100RPM and current value is increase to 650mAmps.

9.3.2 Graph For Sandal Wood

The following graph is drawn for the motor’s speed and current values

![Graph For Sandal Wood](image-url)

Figure 3. Graph For Sandal Wood

The above graph is showing the current and speed values of motor. When the motor current value was increased motor speed was getting low. When the motor speed is 2000RPM current of the motor is 120mAmps. After the load was given motor’s current value gets 400mAmps. Continues of load acting motor’s speed get low to 550RPM and current value is increase to 550mAmps.

9.3.3 Graph For Country Wood

The above graph is showing the current and speed values of motor. When the motor current value was increased motor speed was getting low. When the motor speed is 2000RPM current of the motor is 150mAmps. After the load was given motor’s speed was 1800RPM motor’s current value gets 230mAmps. Continues of load acting motor’s speed get low to and current value is increase to 0.8mAmps.

![Graph For Country Wood](image-url)

Figure 4. Graph For Country Wood

Continues of load acting motor’s speed get low to and current value is increase to 0.8mAmps.

10. Conclusion

This project work has provided us an excellent opportunity and experience, to use our limited
knowledge. We gained a lot of practical knowledge regarding, planning, designing, purchasing, assembling, machining and analyzing, while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. We are proud that we have completed this work with the limited time successfully. We are able to understand the difficulties in modeling and simulation. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed this setup which helps to know how to control a machine by using IOT. The application of this system is high when compared to the cost. By using more techniques, they can be modified and developed according to the applications. This project is an experimental effort to demonstrate a new type of automation in the field of manufacturing by implementing the IOT. So finally we conclude that, it is very useful method for manufacturing in coming days. The result values are given below.

Scope of Future Work

1. Currently work is done for tool diagnostic for one machine. In future it will be extended to Multiple MACHINES.
2. Currently we are only uploading tool diagnostic data to Cloud and Monitoring data in server. In future we will enable machine control too.
3. Future work relates to all axis of control.
4. The same work will be extended to different types of machines.
5. Future work will run the machine at various feed.
6. Future work will work the machine at different current fluctuations.

References


