SUN TRACKING SOLAR PANEL USING 8051 MICROCONTROLLER

MINI PROJECT PRESENTATION

Department of Electronics and Communication Engineering
Gauhati University Institute of Science and Technology

Name: Supratim Paul -- Roll No: 210101011

Name: Parag Nath -- Roll No: 210101018

Supervisor: *Dr. Jyoti Prakash Medhi*

PLAN OF TALK

- Introduction
- Distribution of work
- Block Diagram
- Design Procedure
  - Design per block
  - Circuit diagram
  - List of Components
- Simulation Results
- Observation, Result and Discussion
- Contribution and Limitation
- Future Aspect
- Conclusion
- References

INTRODUCTION

- Solar energy is one of the most abundant and sustainable sources of energy available. However, the efficiency of solar panels is highly dependent on their orientation relative to the sun. Fixed solar panels, which do not move to follow the sun's path, miss out on capturing the maximum possible amount of solar energy throughout the day. To address this limitation, sun tracking systems have been developed to dynamically adjust the position of solar panels, ensuring they are always optimally aligned with the sun.

- The project aims to develop a sun tracking solar panel system using an 8051 microcontroller, a ULN2003A motor driver, a stepper motor, and two Light Dependent Resistors (LDRs). The system automatically adjusts the solar panel's position to maximize its exposure to sunlight, thereby optimizing energy capture.

DISTRIBUTION OF WORK

- The Project actually has two parts:-;

Software part (done by Parag Nath)

Responsibilities:

1.Firmware Development

2.Algorithm Design

3.Communication protocols

4.Testing and Debugging Software

Hardware Part(done by Supratim Paul)

Responsibilities:

1.Design and assemble the circuit

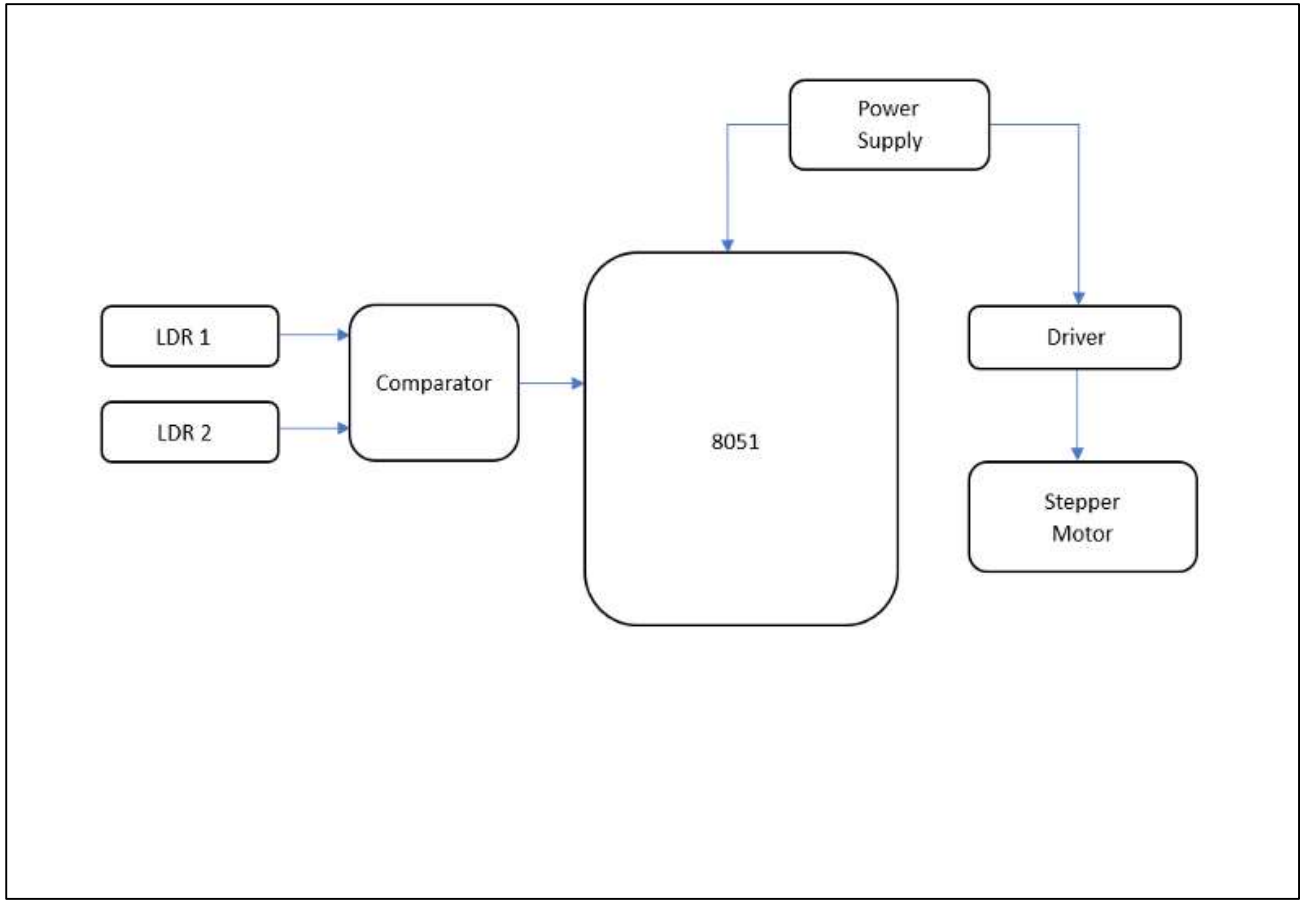
2.Sensor Integration

3.Actuator Integration

4.Power supply Design

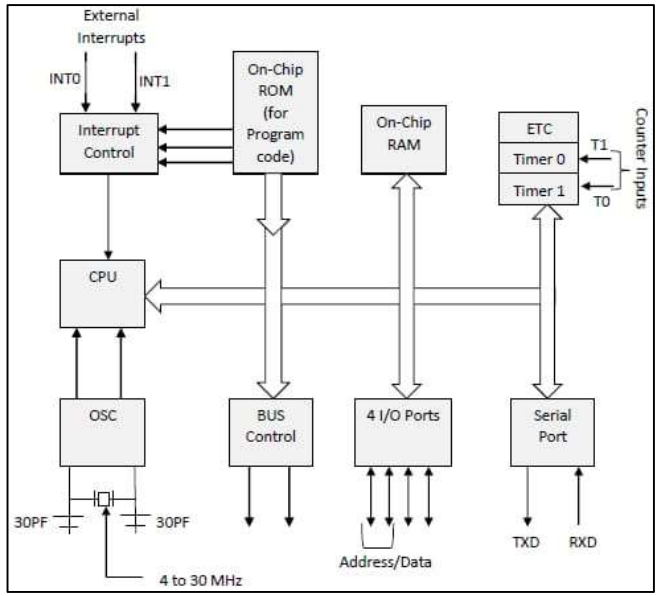
5.Testing and Debugging Hardware

BLOCK DIAGRAM



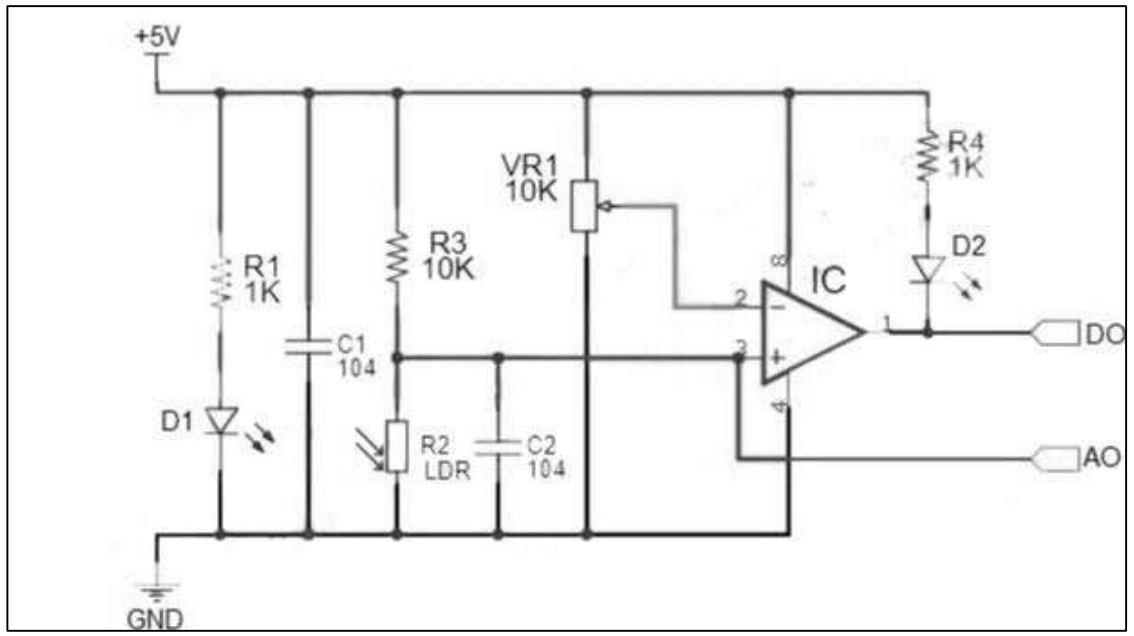
DESIGN PROCEDURE

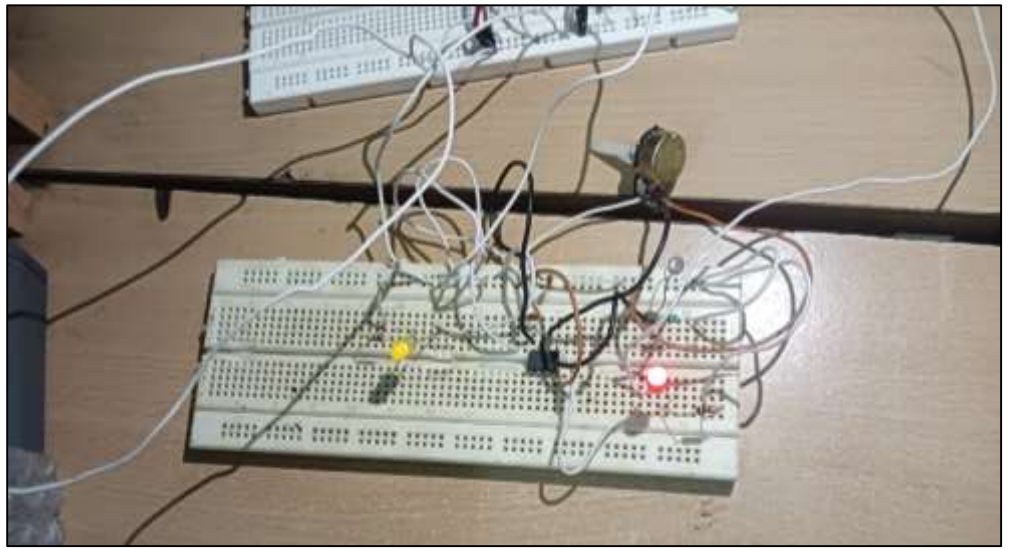
- DESIGN PER BLOCK: 8051 Microcontroller



DESIGN PROCEDURE

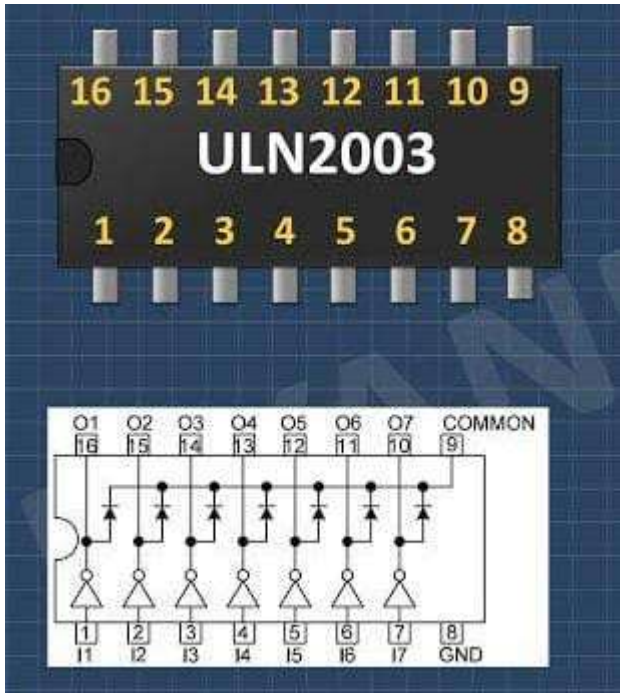
- DESIGN PER BLOCK: LDR Module





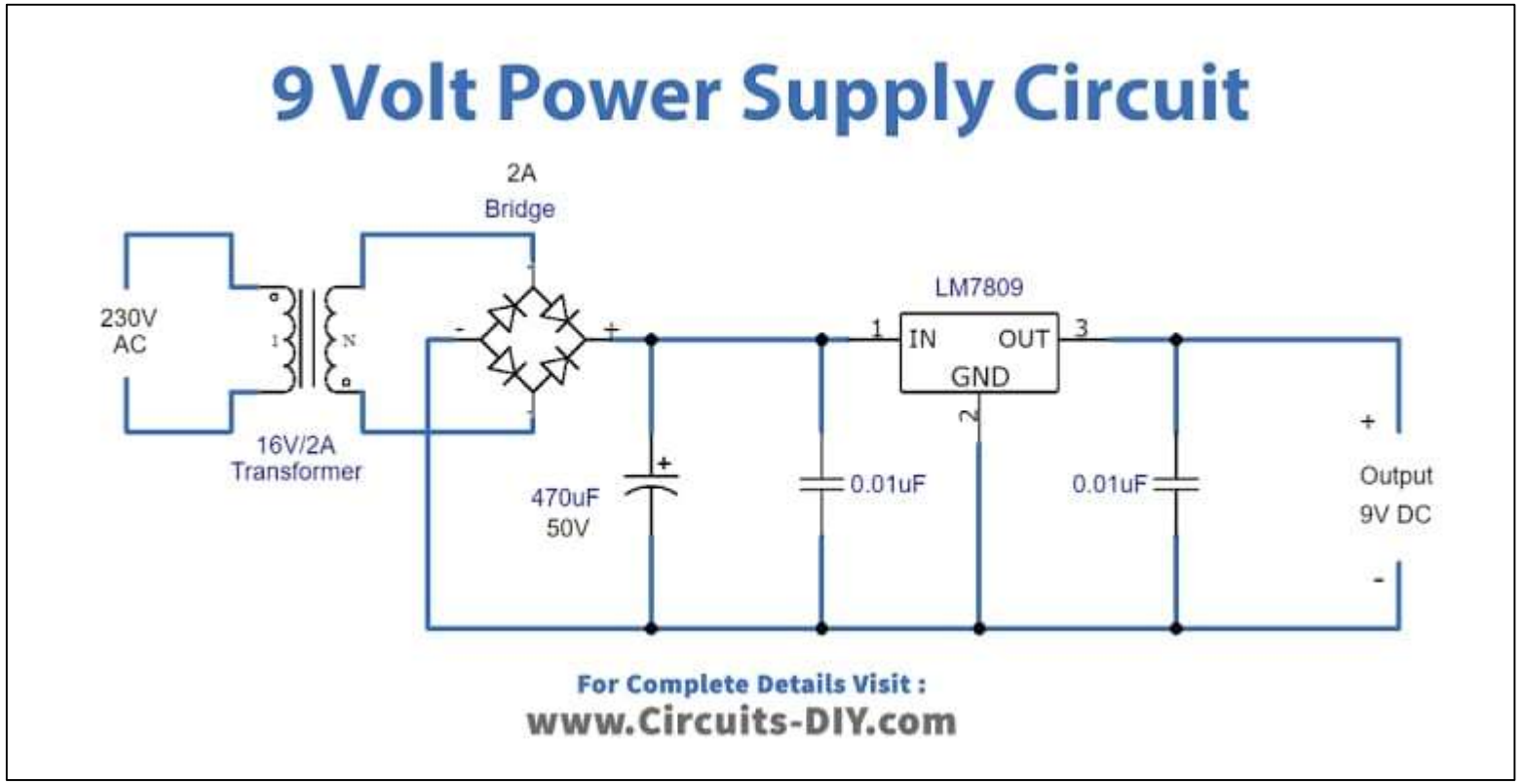
DESIGN PROCEDURE

- DESIGN PER BLOCK: ULN2003a



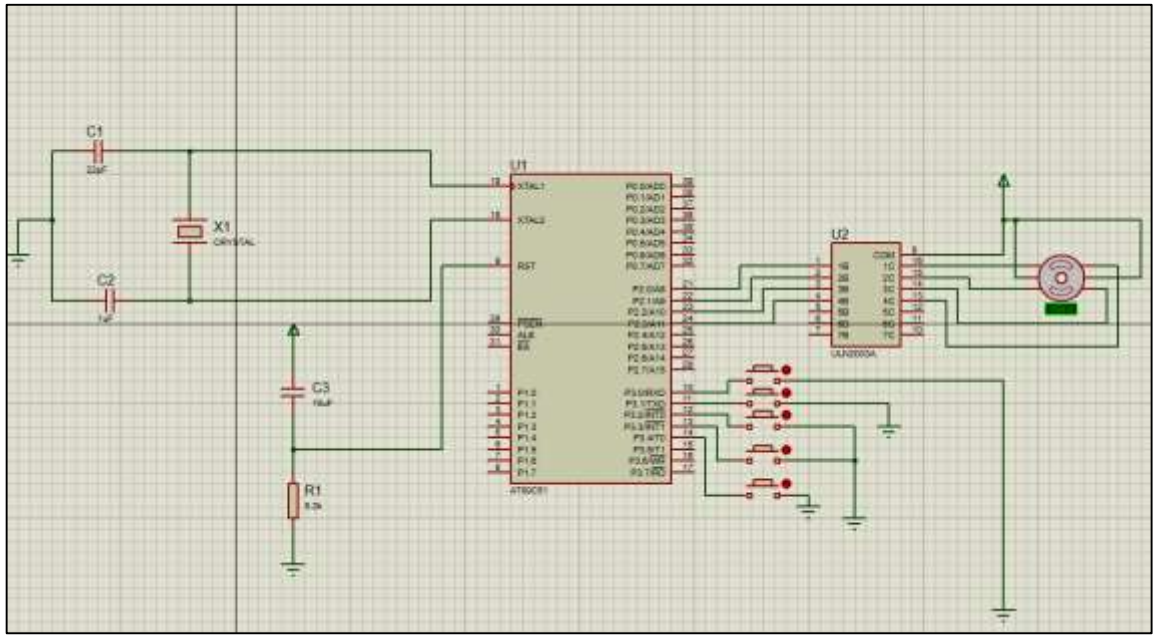
DESIGN PROCEDURE

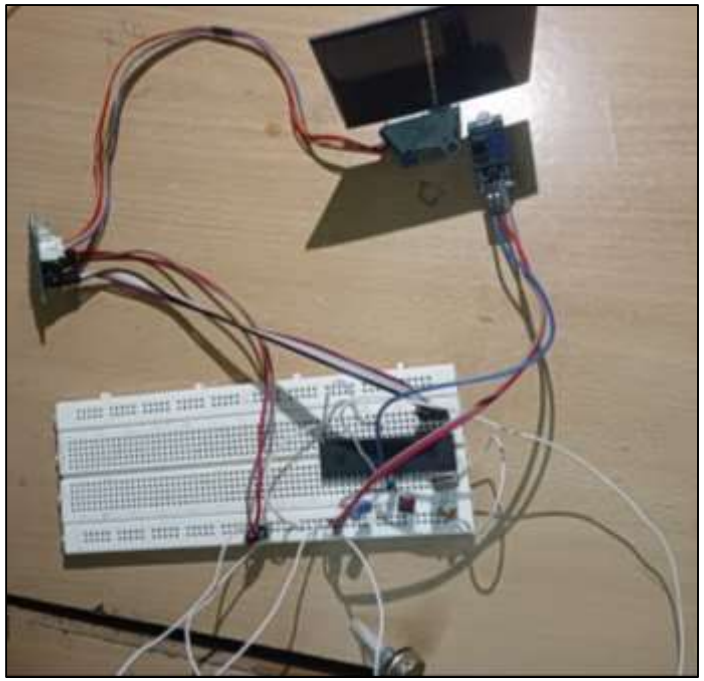
- DESIGN PER BLOCK: Power Supply



DESIGN PROCEDURE

- CIRCUIT DIAGRAM:



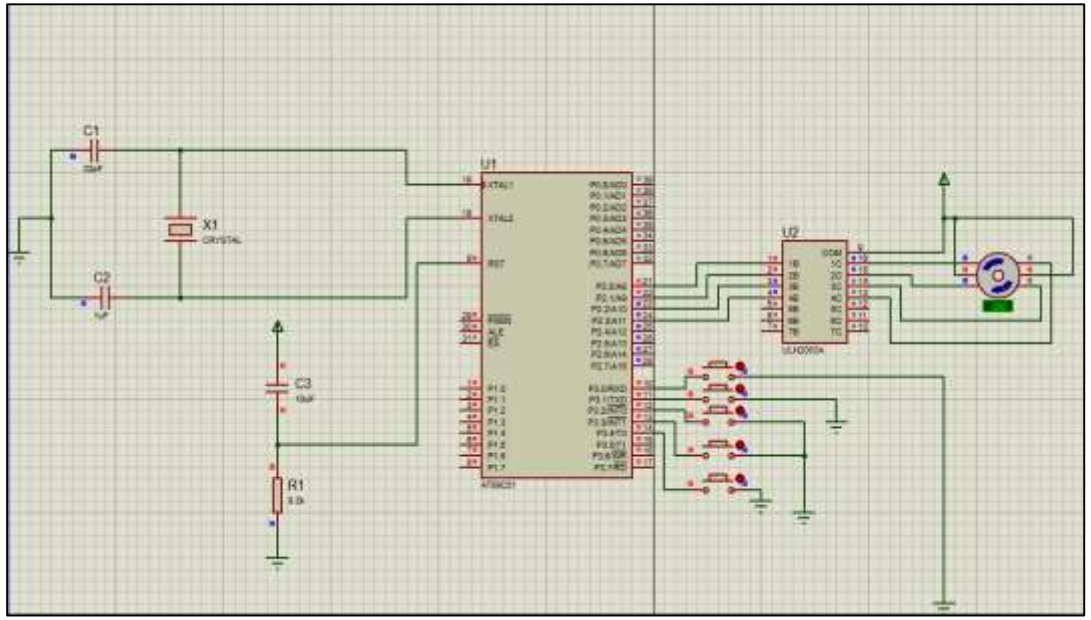


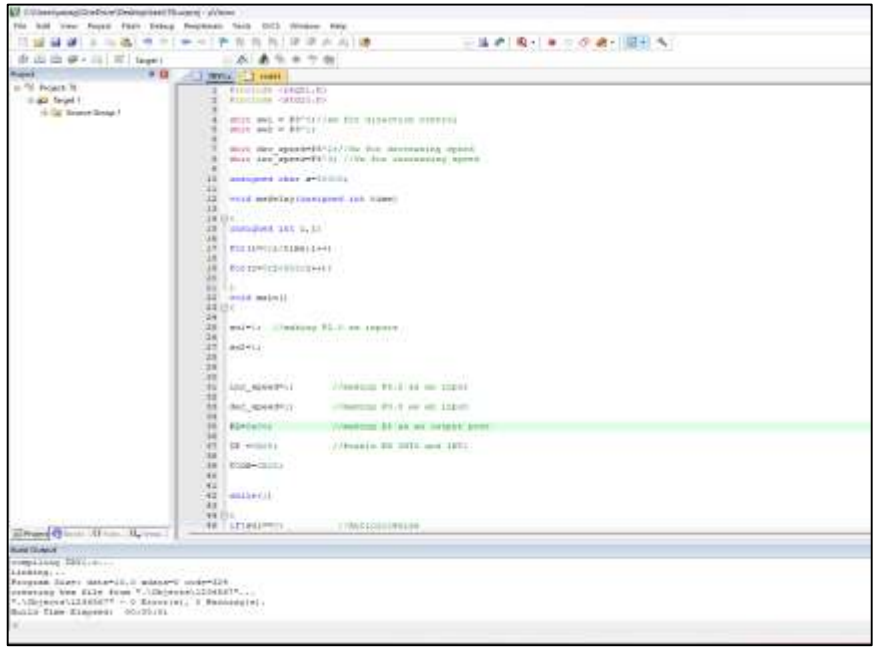
DESIGN PROCEDURE

- LIST OF COMPONENTS:

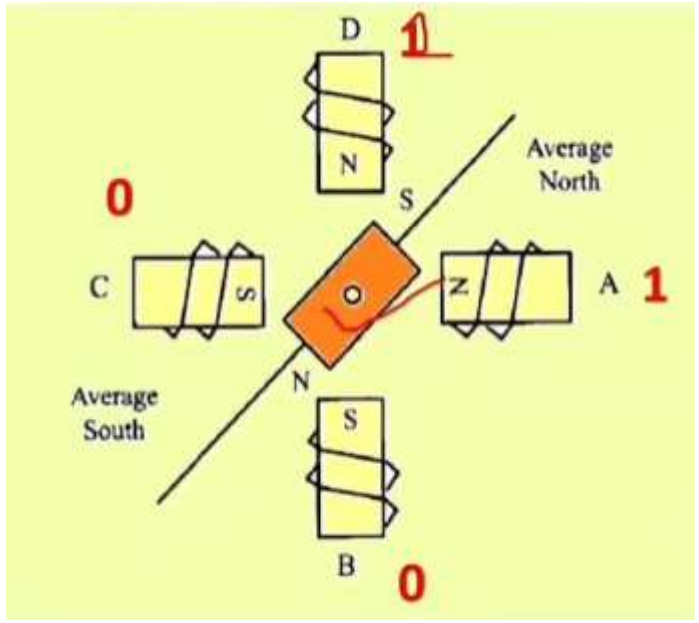
COMPONENT	SPECIFICATIONS
Microcontroller	AT89S51
Driver	ULN2003.
LDR	---
Stepper Motor	7.5 degree per step
Transformer	TRAN-2P2S
Crystal Oscillator	11.0592 MHz
Resistors	100Ω.
Capacitor	33pF, 1000uF.
Potentiometer	10KΩ(3).
Opamp	LM358

SIMULATION RESULT



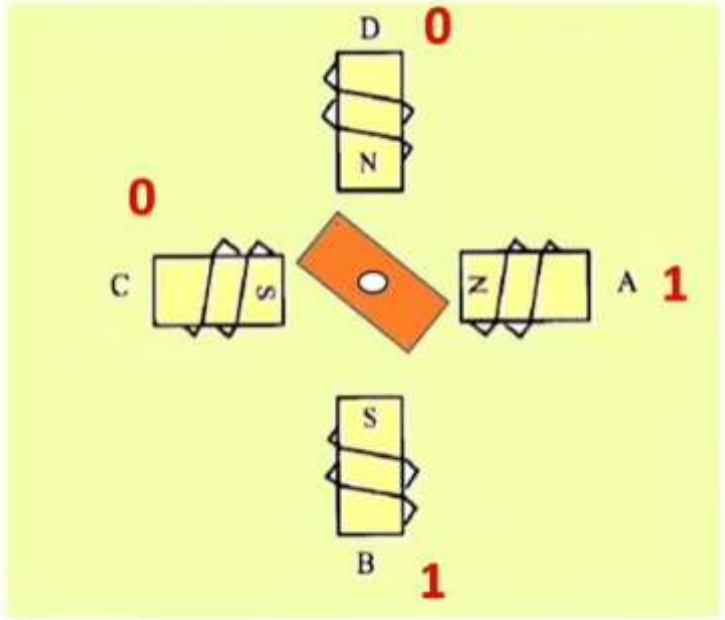


OBSERVATION



Full Mode Sequence

Step	A	B	C	D
1	1	0	0	1
2	1	1	0	0
3	0	1	1	0
4	0	0	1	1



RESULT and DISCUSSION

- Increased Energy EfficiencyThe sun-tracking solar panel system significantly increased the overall energy output compared to fixed solar panels.
- Energy Output Improvement: The sun-tracking system demonstrated an average increase in energy capture of 30-40% over fixed-position solar panels. This was verified through extensive testing over various weather conditions and times of the year.
- Daily Energy Production: The system consistently produced more energy throughout the day, especially during morning and late afternoon hours when fixed panels typically underperform.
- System Accuracy and ReliabilityThe developed system showcased high precision and reliability in tracking the sun.
- Tracking Accuracy: The 8051 microcontroller, combined with light-dependent resistors (LDRs) for sun position detection, accurately adjusted the panel orientation. The tracking mechanism maintained optimal alignment with the sun within a 1-2 degree margin of error.
- Operational Reliability: The system operated effectively in diverse environmental conditions, including partially cloudy days. Fail-safes and calibration routines ensured continued operation and minimized downtime.

LIMITATIONS

- Technological Limitations

1. Microcontroller Limitations: While the 8051 microcontroller is sufficient for basic control tasks, its limited processing power and memory capacity may restrict the complexity and sophistication of the tracking algorithms and sensor data processing.
2. Sensor Accuracy: The accuracy of the light-dependent resistors (LDRs) used for sun position detection can be affected by environmental factors such as clouds, shadows, and dirt on the sensors, potentially reducing tracking precision.
3. Mechanical Wear and Tear: The moving parts of the tracking mechanism, such as the stepper motors and gears, are subject to wear and tear over time, which could lead to maintenance issues and reduced system reliability.

- Environmental and Operational Limitations

1. Weather Dependency: The effectiveness of the sun-tracking system can be compromised in adverse weather conditions, such as prolonged cloudy periods, which limit direct sunlight and reduce the accuracy of sun position detection.
2. Energy Consumption vs. Gain: Although the system is designed to minimize energy consumption, the power required to operate the tracking mechanism might still offset a portion of the energy gains, particularly in low-sunlight conditions or during short winter days.
3. Geographical Constraints: The benefits of sun-tracking are more pronounced in regions with high solar insolation and clear skies. In areas with frequent overcast conditions, the energy gains from tracking may not justify the additional costs and complexity.

- Economic and Practical Limitations

1. Initial Cost: The initial cost of implementing a sun-tracking system, including the microcontroller, sensors, and mechanical components, is higher than that of fixed solar panels. This may deter small-scale or budget-constrained projects from adopting the technology.
2. Maintenance and Durability: The need for regular maintenance to ensure the tracking system's reliability and longevity could increase operational costs and complexity, which might not be practical for all users.
3. Scalability Issues: While the project is feasible for small-scale applications, scaling up to larger solar farms may present challenges in terms of synchronization, increased wear and tear, and higher maintenance requirements..

FUTURE DIRECTIONS

DUAL AXIS SOLAR TRACKING SYSTEM

COMPARING EFFICIENCY WITH FIXED SOLAR PANEL

CONCLUSION

- The development of the sun tracking solar panel system using an 8051 microcontroller, ULN2003A motor driver, and stepper motor represents a significant advancement in renewable energy technology.
- We presented a means of tracking the sun's position with the help of microcontroller. Specially, it demonstrates a working software solution for maximizing solar cell output by positioning a solar panel at the point of maximum light intensity.
- Though the prototype has limitations in hardware areas as an initial set up, still it provides an opportunity for improvement of the design methodology in future.

REFERENCES

1. Augustin, F. Bandello, G. Coscas, C. C. Garcher, and et al, *Macular Edema, A Practical Approach*, C. Gabriel, J. Vaz, A. Loewenstein, and G. Soubrane, Eds. Karger, 2010, vol. 47.

2. IDF, Diabetes Atlas: Std., June 2016. [Online]. Available:http://www.diabetesatlas.org/resources/2015-atlas.html

3. J. P. Medhi and S. Dandapat, "An effective fovea detection and automatic assessment of diabetic maculopathy in color fundus images," *Computers in biology and medicine*, vol. 74, pp. 30–44, 2016.

4. M. B. Lundquist, N. Sharma, and K. Kewalramani, "Patient perceptions of eye disease and treatment in Bihar India 2012," J Clinic Experiment Ophthalmol, 2012.

THANK you