

IOT Based Seed Planting and Watering Rover

G Nagarjuna Reddy, G Maheedhar Reddy, G Balaji, CH Muni Harish, CH Kethan

Department of Electronics and Communication Engineering,

N.B.K.R. Institute of Science and Technology,

Vidyanagar, India.

nagarjunagolamari@gmail.com, maheedharreddy08@gmail.com

Abstract- Exploring Mars and other planets aids scientists in their understanding of severe climate swings that have potential to drastically affect the planets. Humans devised a strategy for colonizing Mars. As a result, before humans set foot on Mars, it's a good idea to grow some plants on Mars and monitor them. This Automated Rover takes on the role of a human by planting and watering the plants on its own. This paper is focused on automated seed planting and monitoring using Internet of Things (IoT). Rover is a movable device that is powered by ESP8266 Node MCU controlled DC motors. Rover is equipped with a DHT11 sensor and a Wi-Fi module that continuously monitors and uploads data to Thingspeak. This rover is equipped with a plough that can be adjusted, a seed dropper, and automated water pouring equipment. An Arduino Nano can be used to control all of the actions. It estimates the distance between each seed after dropping the seed, so that it can water the seeds automatically after 12 or 24 hours. Depending on availability, the rover uses both DC battery and solar energy to power the entire setup. All the rover's actions are fully automated, and no human intervention is required.

Keywords- ESP8266 Node MCU, Arduino Nano, Internet of Things, Seed Sowing, Watering, DHT11, Rover.

I. INTRODUCTION

To do actions more precisely and faster, a robot is controlled electromechanically. They have taken over risky activities that humans either do not want to or are unable to perform. Rover is a contemporary autonomous robot that travels in accordance with the preferences of the operator. This Automated Rover with the capability of performing agricultural tasks without any human interaction. Many different types of rovers may be used on the farm for duties like spraying, collecting fruit, and so on. Guilherme et al. examined how vision has progressed for mobile robot navigation over the previous 20 years. This review looks at numerous aspects of vision development for interior and outdoor navigation by mobile robots thus far [1].

It is necessary to locate a better area to fulfil all of our demands as part of exploring other planets for people to live. However, transporting humans to each planet to inspect the growing conditions will be a more expensive and perilous undertaking. As a result, this technology of autonomous Rovers can make the task easier and more cost-effective.

II. RELATED WORKS

Simon Blackmore and colleagues investigated the potential mechanization of agricultural output. Although the study is ongoing, the overall concept requires a paradigm shift in how we think about agricultural mechanization, with a focus on plant demands and

innovative ways to address them rather than modifying existing procedures [2].

Albert et al. described the design and construction of a distributed wireless sensor network prototype system for tracking mobile search and rescue robots. The robotic gadget can travel autonomously over rubble and seek for living human body heat using its thermal array sensor [3].

Domagoj and colleagues have developed a sophisticated localization system that can be used by both autonomous tractors and humans. This strategy enhanced localization accuracy and might be used in challenging conditions when the Global Navigation Satellite System (GNSS) signal is muted by dense vegetation [4].

Shrinivas et al. created a model based on a robotic platform that may be used to do activities like ploughing on ploughed ground. Without the need of humans, ploughed ground is cultivated mechanically. The inclusion of a microcontroller enables the vehicle's system movements to be continuously controlled and monitored. Objects are detected and guided to their destination using infrared sensors [5].

Hui Liua et al. have provided an infrared radio navigation module, multi-robot board control centers (PCs), a remote server control center (PC), a wireless communication network, and an infrared radio navigation module [6].

Gerard Rudolph Mendez and colleagues developed an automated system that uses three stations: a sensor node, a router, and a server to monitor agricultural conditions in a

pre-programmed way. In an agricultural environment such as a field or greenhouse, the sensor station is equipped with a variety of sensor components such as temperature, humidity, light, air pressure, soil moisture, and water level [7].

Kulkarni et al. have created a novel system that uses autonomous vehicles to enhance speed, accuracy, and life in several agricultural chores including as weed management, cultivation, harvesting, and spraying. A robot with a dc motor and an IR sensor setup was built for steering and commanding. The robot also detects obstacles in the vehicle's route and suppresses weeds in the farm by considering rows per column at a predetermined distance depending on the crop. The robot also detects obstacles in the vehicle's route and suppresses weeds in the farm by considering rows per column at a predetermined distance depending on the crop [8].

Peng Jian-sheng demonstrated an intelligent pesticide spraying robot operated by Wi-Fi. For monitoring, a microcontroller core is employed, and a wireless router is used as the network connection point. The robot performed well in spraying activities over a variety of terrains and crops of varied heights. Because of its low cost, simplicity of handling, and low maintenance, it is ideal for agricultural productivity [9]. Many technologists are attempting to develop more dependable, effective, and faster automation-based technologies.

Shiva Prasad and his colleagues developed a remotely operated farm robot. The internet connects the robot with the remote-control system. Six DC motors control the robot's navigation. The actuator regulates the seeding and fertilization operations [10].

Mahesh et al. investigated the various seed sowing devices available for plantations. Seeding depth, which can be assessed with seed measuring equipment, has been shown to have a significant influence on seeding vigour and crop output. There are many different types of crops, and for high precision pneumatic planters, a wide variety of seed sizes have been devised, resulting in uniform seed distribution throughout the travel route and seed spacing [11].

Andrew et colleagues addressed Automatic Ground Vehicles with the goal of mapping and managing the high amount of variety found in pastoral paddocks. They've developed low-cost, easy-to-use precision agricultural technology that has obvious pastoral farming benefits and the ability to minimize farmer labor [12].

Amol et al. compared the standard sowing method to the newly suggested machine, which can do many activities simultaneously. Reduced sowing time, human effort, and labor cost are just a few of the benefits of these methods. Variables such as row to row spacing, seed rate, seed to

seed spacing, and fertilizer distribution vary with crop [13]. Similarly, mobile robot control system development has achieved new heights in the previous two decades.

Arturo Gil-Pinto et al. explain how they used an Extended Kalman Filter (EKF) to combine wireless network measurements and vehicle sensor outputs to estimate the relative distance and angle between robots, concluding that the Wi-Fi network can also be used as a positioning tool in cooperative robotic applications [14].

Saliyah Kahar et al. investigated how Bluetooth, Wi-Fi or Wireless LAN, and 3G may be utilized to operate mobile robots. The type of wireless technology to be utilized is defined by the type of app to be created, but it must also consider the following factors: data rate, range, and frequency [15].

Sudarshan and colleagues have developed a rover that can navigate using remote orders from an operator. Real-time communication was established with as low lag as feasible. An algorithm is developed that allows the automobile to be securely operated from a distance. Communication between the client and the rover is established using the connection parameters provided by the operator [16].

Shashank was able to communicate with two computers utilizing Wi-Fi as the communication medium. These computers are linked by Wi-Fi, which sends serial data, and a link is established between one computer near the robot and a microcontroller, which controls the robot's trajectory [17]. Wireless communication is essential when controlling from a great distance. A robust robot that can communicate wirelessly via a Wi-Fi network or the internet has been created. There are multiple buttons on the web page that signify various duties, making robot control simple. A rapid and high-quality image transfer is also possible while using an Android device [18].

Yuxiang Sun et al. developed a system for indoor Wi-Fi signal strength-based localization that compares the standard K - Nearest Neighbors (KNN) algorithm to an upgraded KNN algorithm, with the probabilistic technique offering around 2m localization accuracy in the test setting [19].

Won-Shik Na and Seok- Hoon Kim designed an Efficient Data Forwarding Scheme (EDFS) to assist efficient data transfer of IoT devices because Wi-Fi technology is not suited to manage this data [20].

Muthiah and colleagues proposed the creation of a cleaning robot controlled by RF signals and an Induino (microcontroller). They also include features like a wireless camera that make human interaction with the robot simple and straightforward. To control a mobile robot remotely [21],

Gonca Ersahina et al. employed an android interface application. The Android operating system was created with the goal of making it more user- friendly, and it can be used by multiple users on their own devices [22].

Mohammed Saquib Khan and colleagues have developed a Wi-Fi controlled robot composed of three modules: a Wi-Fi module, a router, and a microprocessor that performs all of a robot's fundamental operations. To connect the Microcontroller to the Wi-Fi module, a webpage was constructed [23].

As the preceding literature study shown, current seeding procedures are either complex or time consuming. Seed waste, a staff scarcity, and a number of other issues all have an influence on crop output. Agricultural automation is required to compensate for these problems. A simple flap and servomotor mechanism was used to replace existing complicated seeding systems in this study, which enhanced seeding accuracy and precision.

Similarly, most robot control literatures employ accelerometers; flex sensors, RF modules, and Wi-Fi technologies to control the robot, all of which have disadvantages. These can only operate robots within a certain radius, but the Internet of Things allows you to control the robot from a distance [24]. There are certain real-world difficulties, such as a lack of control choices in agricultural applications. The usage of IoT as a communication channel may be able to assist solve these problems [25].

III. DATASET DESCRIPTION

We have collected data from various website about different seeds and the conditions where they can be grown. The Source code can be changed for different seeds according to the data collected. For test results presented in this paper, the data of peas from morningchores [26] were used.

IV. METHODS

1. Existing System:

There are a variety of seed-dropping devices available, all of which are quite effective. These systems can perform a particular task, like as dropping seeds or watering plants, but they must be controlled by humans, and a human must oversee all of the system's actions. The current approach creates a passage for the seeds, drops the seed in it, and then closes the path. Another system will be required for watering.

2. Problem in existing system:

Even the current system is sufficient to sow seeds. There are only a few things you can do with it. There was no way to track the temperature before and after the seeds were dropped, and it couldn't hydrate the plants. As a

result, the system we propose will be able to accomplish operations that existing systems are unable to.

3. Proposed System:

In many areas, the suggested approach will be more efficient than the current system. This technology can keep track of the temperature and humidity in real time, where the existing systems didn't used this methodology to drops the seeds. It only drops the seed if the appropriate temperature and humidity are found to grow the designated seeds. It continuously uploads the temperature and humidity values to Thingspeak, where humans may view the changes, in addition to seed falling.

Along with them, this system is configured to drop seeds at predetermined intervals and assist in watering the seeds after predetermined time periods. This system is built in such a way that it can run on both solar and battery power. As a result, we can say that it can work for a longer period of time than the standard system.

V. WORKING MODEL

This system will first check the humidity and temperature and then upload the results to Thingspeak. If the uploaded temperature and humidity data corresponded to the initial values specified in the code, i.e., the conditions under which the desired seed may develop. It simultaneously drops the seed and waters it. Otherwise, if the appropriate conditions are not obtained, the Rover will continue to move forward until it discovers the desired conditions for dropping the seed.

Furthermore, the readings from DHT11, such as temperature and humidity, will be continuously posted to the thingspeak for every 15-30 seconds. Where humans can use the internet to remotely monitor the temperature and humidity from anywhere. As a result, this device requires continual internet connectivity in order to post data to a thingspeak. The DHT11 Sensor Values Upload to thingspeak was shown in fig.1 & fig.2.

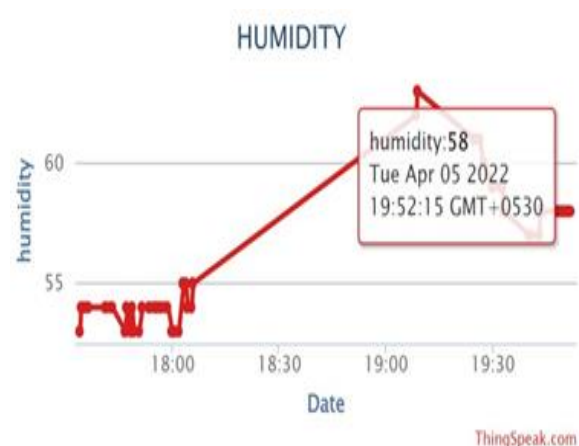


Fig 1. Humidity Values Uploaded to Thingspeak.

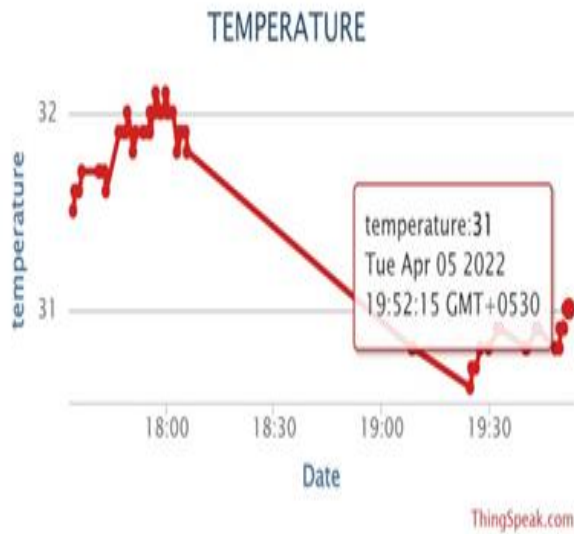


Fig 2. Temperature Values Uploaded to Thingspeak.

Arduino Nano will control the movement of seed dropping and irrigation. Where it receives a signal from the Node MCU indicating when to drop the seed and irrigate the plant. When the rover comes to a halt, the Node MCU transmits a signal to the Nano Board, which activates the seed dropping servo device and the water pump. The seed dropping system is with servo motor is shown in fig.3

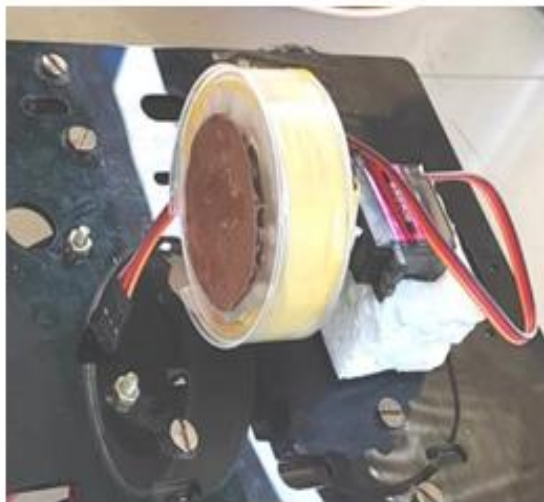


Fig 3. Seed Dropping System.

Once it has found the ideal situation for dropping the seed, it drops the seeds at a certain time interval that corresponds to dropping seeds at the same distance. After dumping a certain quantity of seeds, it comes to a standstill for 24 hours (Number of seeds to be dropped will be specified in the code).

After 24 hours, the rover will begin moving again to water the seeds. This process will continue until the seeds develop into seedlings. The detailed flow model of the system was shown in fig.3.

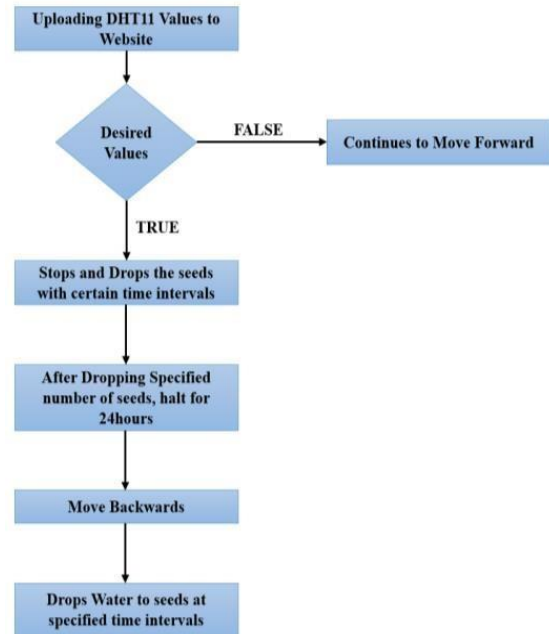


Fig 4. Flow Model.

The final working model of the with all the equipment installed was shown in the fig.5.



Fig 5. Final Working Model.

One of the best features about this rover is that it works with both solar and battery power, so we don't have to worry about the device's power supply.

VI. CONCLUSION

The creation of an IoT controlled Rover for autonomous seeding and watering was supported the event of an IoT system and also the conceptual design of the Rover, and also the following conclusions were reached:

Instead of past semi-automated complex seeding methods like levers, plungers, and cams, an automatic seeding Rover with an easy flap mechanism was invented. An IoT-

enabled Rover with a newly designed Flap-servomotor system offers significant advantages over conventional technologies. A newly built hardware, the ESP 8266 version 12 Wi-Fi modules, was employed to realize an oversized range of wireless control with no data transfer delays. Using Arduino software to drive servomotors allows for accurate seeding control.

The Arduino programme also provides time delay transformation. The gap between two successive seed drops is often changed by adjusting the delay. Further progress within the agricultural sector could also be achievable with the employment of IoT. The utilization of electronic control with IoT within the agricultural area will push the boundaries of engineering streams beyond what's currently possible. To enhance control capabilities in agricultural environments, a classy microcontroller like the Raspberry Pi, as an example, will be employed.

Future enhancements could include live video streaming at the farmer end. Continued video transmission will allow the farmer to regulate the Rover from a distance. Rover could also be outfitted with other sensors and mechanisms to perform other agricultural tasks like as weeding and pesticide application

REFERENCES

- [1] DeSouza, Guilherme N, Avinash C. Kak. "Vision for mobile robot navigation: A survey." IEEE Transactions on Pattern Analysis and Machine Intelligence; 24(2), (2002), 237-267.
- [2] Blackmore B S, Stout W, Wang M, Runov B. "Robotic agriculture – the future of agricultural mechanisation?" 5th European Conference on Precision Agriculture. The Netherlands, Wageningen Academic Publishers. (2005); 621-628.
- [3] Ko, Albert, Henry YK Lau. "Robot assisted emergency search and rescue system with a wireless sensor network." International Journal of Advanced Science and Technology. 3, (2009),69-78.
- [4] Drenjanac, Domagoj, Slobodanka Tomic, Juan Agüera, Manuel Perez-Ruiz. "Wi-Fi and Satellite-Based Location Techniques for Intelligent Agricultural Machinery Controlled by a Human Operator." Sensors. 14(10),(2014)19767-19784.
- [5] Zanwar, Shrinivas R, Kokate R D. Advanced Agriculture system. IAES International Journal of Robotics and Automation. 1(2), (2012)107-112.
- [6] Liu, Hui, Norbert Stoll, Steffen Junginger, Kerstin Thurow. "A common wireless remote-control system for mobile robots in laboratory." In IEEE International Instrumentation and Measurement Technology Conference (I2MTC). (2012); pp. 688-693.
- [7] Mendez, Gerard Rudolph, Subhas Chandra Mukhopadhyay. "A Wi-Fi Based Smart Wireless Sensor Network for an Agricultural Environment". In Wireless Sensor Networks and Ecological Monitoring. (2013); 247-268.
- [8] Kulkarni V A, Ajit G Deshmukh. "Advanced Agriculture Robotic Weed Control System." International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering. 2 (10), (2013) 5073-5081.
- [9] Jian-sheng, Peng. "An Intelligent Robot System for Spraying Pesticides." The Open Electrical & Electronic Engineering Journal. 8, (2014), 435-444.
- [10] Shivaprasad B S, Ravishankara M N, Shoba B N. "Design and implementation of seeding and fertilizing agriculture robot." International journal of application or innovation engineering & management (IJAEM), 3 (6), (2014).
- [11] Mahesh R, Pundkar A. "Seed sowing machine: A review." International journal of engineering and social science. 3 (3), (2014) 1-5.
- [12] Manderson, Andrew, Chris hunt. "Introducing the agri- rover: an autonomous on-the-go sensing rover for science and farming e-book". 1-14, (2013).
- [13] Amol B Rohokale, Pavan D Shewale, Sumit B Pokharkar, Keshav K Sanap, "A review on Multi-Seed Sowing Machine." International Journal of Mechanical Engineering and Technology. 5(2), (2014)180-186.
- [14] Gil-Pinto, Arturo, Philippe Fraisse, Rene Zapata. "Wireless reception signal strength for relative positioning in a vehicle robot formation." IEEE 3rd Latin American Robotics Symposium LARS' 06, (2006), 100-105.
- [15] Kahar, Saliyah, Riza Sulaiman, Anton Satria Prabuwono, Nahdatul Akma Ahmad, Ashri Abu Hassan M. "A Review of Wireless Technology Usage for Mobile Robot Controller." In 2012 International Conference on System Engineering and Modeling. 34, (2012), 7-12.
- [16] Sudarshan B T, Namradha, Pradeep, "Wi-Rover: A Wi-Fi Controlled Remotely Operated Video Enhanced Receiver." International Journal of Computer Applications. 56(7), (2012), 1-9.
- [17] Moro, Shashank U. "WIFI Enabled Smart robot." Conference: Science, Engineering and Technology. (2013), 1-5.
- [18] Gaikwad, Kunal Borker-Rohan. "Wireless Controlled Surveillance Robot". International Journal of Advance Research in Computer Science and Management-Studies. (2014), 2321-7782.
- [19] Sun, Yuxiang, Ming Liu, Max Q-H Meng. "WiFi signal strength-based robot indoor localization." In IEEE International Conference on Information and Automation (ICIA). (2014), 250-256.
- [20] Won-Shik Na, Seok-Hoon Kim. "An efficient data forwarding scheme for internet of things in Wi-Fi networks." Indian Journal of Science and Technology. 8(1), (2015), 112-117.
- [21] Muthiah M, Nirmal K, Sathiendran RK. "Low-cost radio frequency-controlled robot for environmental

- cleaning.” In International Conference on Circuit, Power and Computing Technologies (ICCPCT). (2015), 1-5.
- [22] Ersahin, Gonca, Herman Sedef. “Wireless Mobile Robot Control with Tablet Computer.” *Procedia-Social and Behavioral Sciences*. 195, (2015), 2874-2882.
- [23] Mohammed Saquib Khan, Ataur Rehman Khan, Altamash Khan, Akmal Kalia, Lochan Bisne. “WI-FI Based Robot Controlling by Webpage Interface and Video Monitoring.” *International Journal of Emerging Technology and Advanced Engineering*. 5(4), (2015), 2250-2459.
- [24] Dnyanesh Jalamkar, Arockia Selvakumar A. “Use of Internet of Things in a Humanoid Robot”
- [25] Skansholm, Jan (2000). *Vägen till C [The road to C]* (in Swedish). Studentlitteratur. pp. 237–774. ISBN 91-44-01468-6.
- [26] “The Right Seed Germination Temperature for Your Plants” By Ame Vanorio, <https://morningchor.es.com/seed-germination-temperature/>