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Development of UAV Quadcopter using Pixhawk for Traffic Handling

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ABSTRACT: Unmanned Aerial Vehicle (UAV) quadcopter is widely used in various applications such as traffic surveillance, check crops condition, logistics, military also incorporate use of UAVs as they can operate in critical conditions. Lately, because of increase in modern technology there is equal growth in automobile this will creating huge amount of traffic jam, sound pollution and air pollution. In this situation, a lot of time is wasted on roads while travelling from one place to another. This study focuses on assembly of quadcopter and its applicability for traffic surveillance along with limitations associated with wide scale use of UAVs, solutions to overcomes these limitations.

KEYWORDS: Quadcopter, Unmanned aerial vehicle (UAV), Traffic surveillance, Vertical take-off and landing (VTOL).

I. INTRODUCTION

Unmanned Aerial Vehicle (UAV) is a drone that flies without a pilot aboard. It could be controlled remotely or autonomously utilizing a gyro pilot framework. They are deployed in different areas such as photography, military, surveillance, and so on.UAVs can have various number of rotors ranging from three, four, six, or eight. Thequadcopter is the most commonly used UAV as it is having less complex mechanism and is cost friendly compared to other UAV types.

As blockage proceeds to develop on cutting edge roadway, collecting opportune and exact activity information is crucial in both activity operations and administration. Conventional activity checking is accomplished by conveying stationary activity reconnaissance gadgets within the transport arrangement. Specifically, activity reconnaissance cameras have been broadly embraced by transportation offices for both instantaneous activity and occurrence administration. By utilizing video analytics methods, activity reconnaissance cameras not only use to capture activity information but to also give on-going occurrence scenes to occurrence administrators. With their points of interest, these cameras are still unable to show activity conditions past their view angle.

In later a long time, little rambles have ended up well known with the progressions of modernair traffic control innovations. The most recent and the foremost significant advances incorporate 1) GPS based position hold, 2) long-range wireless video transmission, 3) programmed flight help, and 4) fail-safe usefulness. Such innovations empower civilian administrators to utilize small rambles in a simple secure way. One of the foremost well-known sorts of little rambles would be quadcopter, which are capable of performing vertical take-off and landing (VTOL) whilst drifting in air.

Little quadcopter offers promising possibilities to handle the limitationsof stationary activity reconnaissance gadgets. The VTOL diminishes lags for fast arrangement. In expansion, with GPS based position hold innovation and floating options, moment and adaptable activity surveillance is possible with quadcopters. we inspected the appropriateness of utilizing UAV to record activities where stationary activity reconnaissance gadgets can't access.

UAVs are competent to cover bigger regions surpassingfixed sensor systems. The eccentric nature of activity occurrences, the adaptability which UAVs gives may be an idealize support to the conventional fixed sensor systems. The flight route isn't prohibitive to the ground network and activities, UAVs move better and faster than ground vehicles, particularly beneath congested roadway induced by traffic mishap. Within the occasion of extreme activity mishaps, this may well be possibly vitalizing. Within the numerous frequencies of mischances, UAV observing might

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give basic data, making a difference makes the quick responders to prioritize the occurrence medicines and designate restricted development assets.

Quadcopters may fly much closer to the ground and the overhead viewpoint of the quadcopter offer assistance officer to quickly record accidents, encouraging speedier mishap clearance. UAV floating ability is one of the foremost invaluable highlights and it helpsit gather more steady film for simpler activity information prepping.

In spite of the promising preferences, it is worth noticing the challenges of little quadcopter rambles. To begin with their payloads are regularly restricted. The relative light-weight makes them more vulnerable to wind and many natural components. UAVs more often than not have restricted control supply as explained in[1].

The applicability of small quadcopter drone as a traffic surveillance tool has been investigated through multiple tests. [1] used a small quadcopter drone that is low-cost and easy-to-control micro unmanned aerial vehicle which does not require professional knowledge and handful skills of aircraft control.

A study for complete designing and manufacturing process of quadcopter from the engineering perspective and improving their balance and stability system was carried out [2]. It presents the mechanical structure and describe all parts of quadcopter which gives good solution for a quadrotor design when its dimension and cost are the main constraints.

Specialists are attempting to create controls that guarantee security and commotion to do with citizens and simultaneously increment the productivity of the administrations given by quadcopter innovation. It is conceivable that quadcopters could have a framework that detects any incalculable alter in climate conditions and the framework naturally stops action utilizing a few instruments [3].

UAVs operations are restricted by their battery life. Travel time of quadcopter can change based on cells and sort of quadcopter; regular travel time is about half an hour given that no other sensor is getting control from its battery. Analysts are attempting to make strides battery life of quadcopters and utilize elective vitality sources such as sun-based vitality. Quadcopters may travel longer time within the time ahead [4].

[5] shown the plausibility of utilizing UAV for following vehicle development in a crossing point, watch blockage on the organize, observing stopping parcel utilization straightforwardly from the video. [6] utilized the vehicle direction information procured from quadcopter video for analyzing hole acknowledgment for an urban crossway without activity flag and controlled utilizing Halt sign. They analyzed this based on manually observing the UAVs recordings.

II. METHODOLOGY

This research is isolated into different stages as portrayed in Fig 1. It started with gathering the components. Following, the usefulness of each component is tried to see on the off chance that all the components can work well. The handlingof framework setup and sensors calibration is next for the program to give fruitful notices. At that point, the programmed flight direction is produced utilizing Mission Organizer computer program and implanted to the Pixhawk controller. Using this implanted direction, the quadcopter flies independently, and the flight information is recovered from the sensors. The flight information is at that point prepared to be sifted and synchronized. Following, an assessment is run by calculating the cruel squared blunder between the required scope and longitude waypoints and the genuine direction from the quadcopter flight information.

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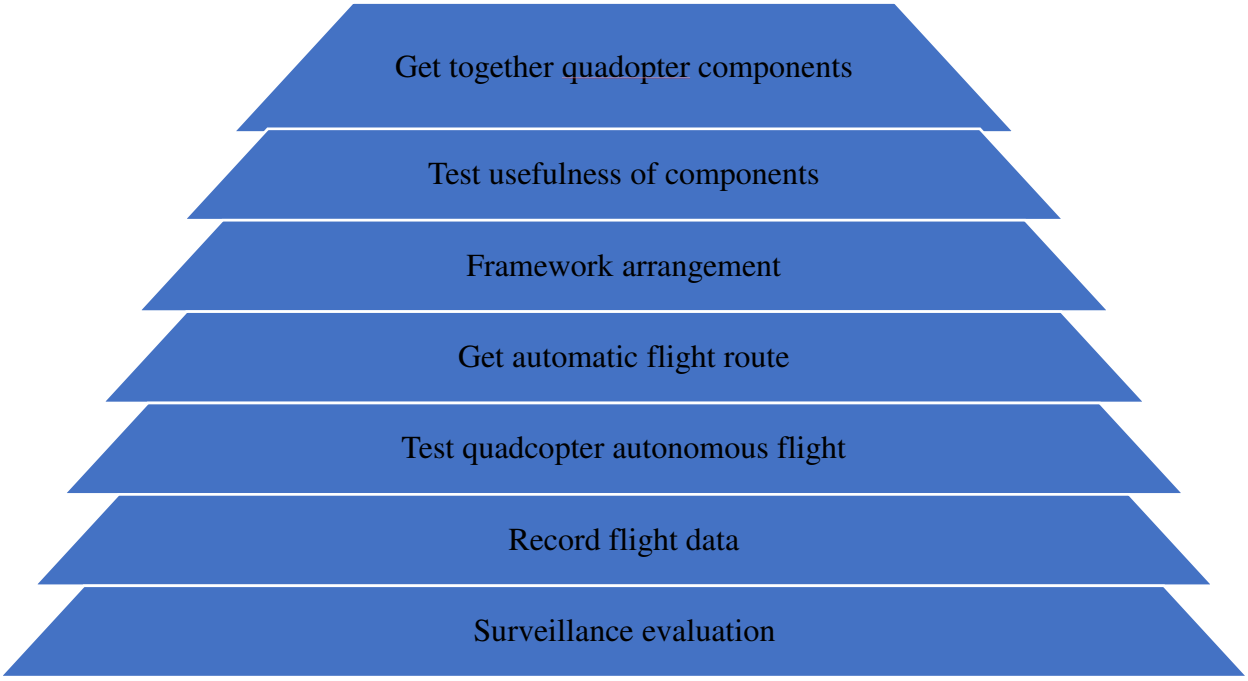

Fig 1. Research Methodology

III. QUADCOPTER STRUCTURE

The main portion of the quadcopter outline has four arms. The outline has a battery, motors, controller board, propellers, recording device and sensors. The speed of the motors is controlled by Electronic Speed Controller (ESC). The motors are put equidistant from the middle on inverse sides. Fig 2 shows how these parts are positioned on the outline.These days, primary structure comprises of an outline consisting of carbon composite materials to extend payload and diminish the weight.

Fig 2. Quadcopter Structure

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Various Component of Quadcopter:

1. Canopy
2. Blade (propellers)
3. Brushless Motors
4. Landing Skid
5. GPS Antenna
6. Control Board
7. LIPO Battery
8. Frame
9. LED Lights (Front)
10. LED Lights (Back)
11. Camera with Lens Cap

IV. DEVELOPING THE QUADCOPTER

A quadcopter with dimension of 650mm (Tarot 650 frame) diagonally is developed. The components are listed in table 1 below. Fig 3 illustrates the quadcopter arrangement in block diagram. Theremote-control collector, radio telemetry, GPS module, security switch, alarm, and electronic speed controls (ESCs) are specifically connected to Pixhawk controller and is the center of the framework.The magnetometer, gyroscope, barometer, and accelerometer all encompasses the Pixhawk controller. All motorsare associated to an ESC and the electric current is gotten from the cell by means of the power module. The power module isolates the electric current in pairs, one is devoted to power the Pixhawk controller and the other one is utilized to power the four ESCs.

Table 1. Quadcopter Components

Tarot Ironman 650 Carbon fiber frame
Tarot 4008 Martin Brushless Motor TL2955
40A 2-6S Brushless ESC
T4-3D 3 Axis Brushless Camera Gimbal
Pixhawk PX4 32bit
TF mini-Lidar laser
LIPO Rechargeable battery 14.8v 10000mAH
Carbon fiber propellers
EC5 Connectors
TS832 5.8G 600mW Wireless Transmitter
5.8G UVC OTG Android Phone Receiver
High sensitivity vibration sensor module
TFT Touch LCD Screen for Raspberry pi 3.2 inch
Raspberry pi camera
Mi 360 home security camera
Lavalier microphone with 6 audio cable
TCS3200 based color sensor module

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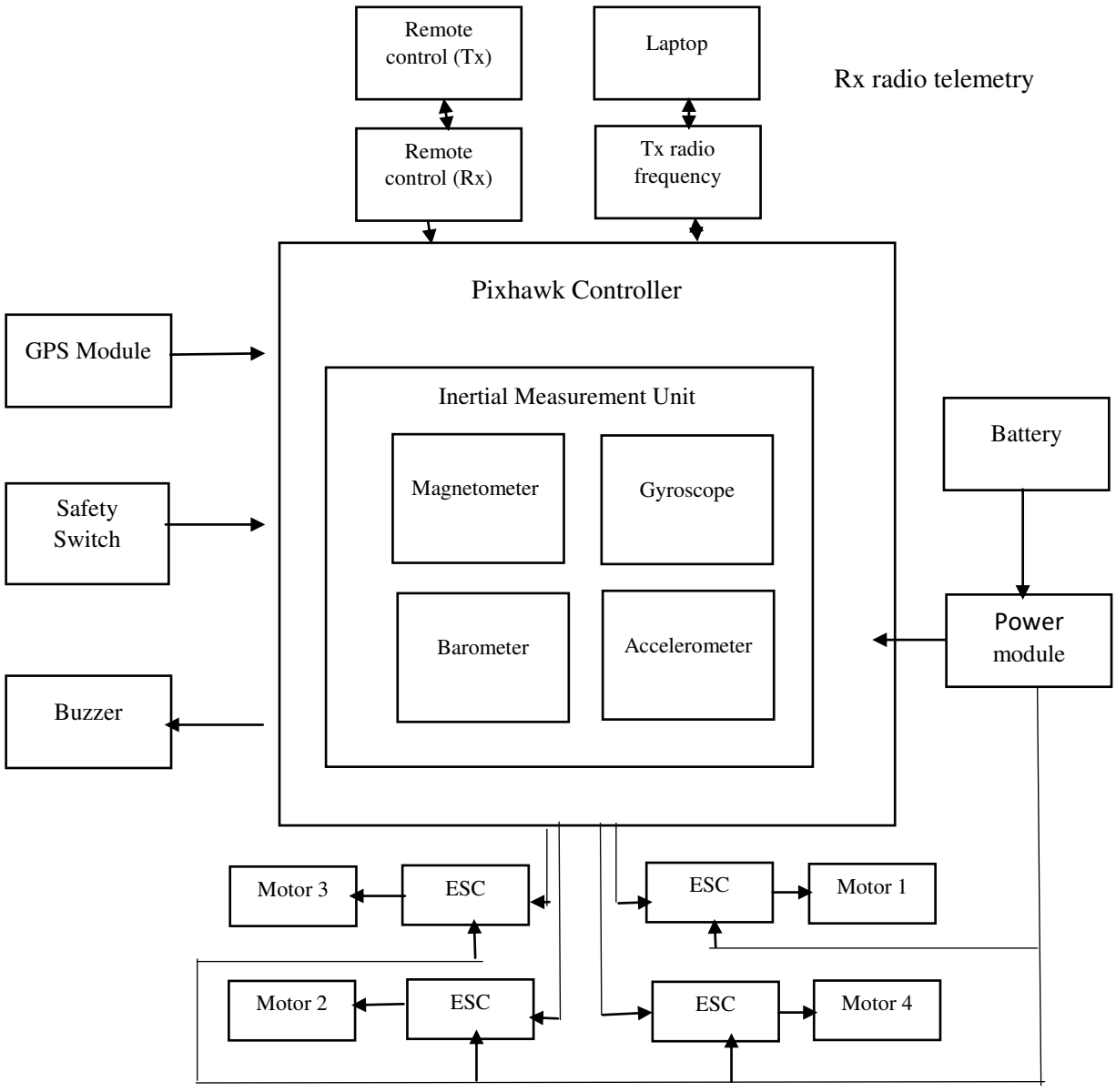

Fig 3. Block diagram of quadcopter

The quadcopter plan is of inserted framework stage. The microcontrollers control the execution of flight component and recordings.The battery provides the power supply of the UAV. These make the UAV to keep steady flow while it is drifting.

By and large X sort outline utilized within the UAVas they are thin solid sufficient to resist distortion. For the most part distance across of the circle of outline zone for scaled down aerial vehicle is between 1/4m and 1m. If the outline is subjected to turning stack, the sum of miss happening is related to the cross-sectional shape area. Though firmness of strong structure and torsional firmness of closed circular area is lower than closed circular cross-section. This decreases overall weight.

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IV. RESULT AND DISCUSSION

A quadcopter was made based on the block diagram, and then assembled for further testing and weighed 2.5kg. Testing is done for the duration of the quadcopter battery performance and flight balance. The quadcopter can be seen in Fig 4.1 and 4.2 respectively.

Fig 4.1 Developed Quadcopter (A)

Fig 4.2 Developed Quadcopter (B)

Battery performance testing with propeller attached was conducted. Propeller is attached so that it doesn't fly uncontrollably when the throttle is raised to maximum throttle. The battery time achieved with full throttle on is 12 minutes 24 seconds.

Flight test is done and after some failure the drone managed to balanced itself when hovering the throttle for take-off is approximately around 1200. The maximum height of the quadcopter is more than 20 meters.

Traffic surveillance;

This section deals with two traffic surveillance applications by using the quadcopter drone. In order to examine the impact of altitudes on the quality of the captured video footages for data collection, 10-minute video footages recorded at the altitudes of 45-ft and 90-ft were analyzed. The video footages were also processed through a video analytics program. It must be noted that the stability of video footages heavily relies on the wind speed. The video footages collected from the quadcopter may not be perfect for video analytics software that was applied.

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Besides traffic volume, queue length, delay, headway, and saturation flow rates are crucial measures to determine the performance of an intersection. Collecting those measures from intersections are often challenging due to lack of proper data collection devices and man power. For example, to capture queue lengths of a certain intersection, the data collection device needs to cover the upstream of an intersection as far as the queues are likely to exist. Therefore, it would be challenging within the current data collection practice. Owning to the overhead perspective of the drone FPV, these crucial measures could be collected certainly by manual effort and potentially by stable video analytics software.

Live video footage of a roadway incident is one of the most crucial information for roadway incident management. Under current practices, live incident video footage is collected by closed circuit television (CCTV) cameras closely located around the incident scene. Out of the coverage of available CCTVs, it is impossible for a TMC to obtain the video footage of an incident scene. Small quadcopter drone is easy to launch as it requires no dedicated spaces to take off. In that sense, small quadcopter drones would be suitable for rapid deployment to capture video footage of a roadway incident which is out of CCTVs' coverage.

V. CONCLUSIONS

Quadcopter implementation within the transportation field particularly in security and traffic checking have been fundamentally surveyed. Vision calculations and picture prepping is seen as a vital component that bringsabout progress in application of UAVs to utilize mishap investigation and activity stream investigation. The general view from abovefrom camcordersof quadcopters is imperative because it permits extricating cars directions with increased exactness. Future scenarios are to talk about alongside the accentuation on open acknowledgment for more improvements and use of UAVs.

Future Scope:

One of the building pieces for any shrewd city is its dependence on Intelligent transport frameworks. Independent and associated vehicles are one viewpoint; be that as it may, other features of transportation moreover ought to move towards mechanization such as interstate upkeep, traffic personnel. Wide-scale arrangement of quadcopters alongside calculations can empower such robotization. Roadside Units bolster communications to realize the objective of smart framework. Utilize of quadcopters to this kind of collaborative system not just gives a way to pass innovative limitations like misfortune in line of locate communication, parcel misfortune, idleness, retransmission overhead, but bolster other ad hoc communication systems by sharing a few of their assignments. Human obstructions and UAVs robotized administration framework ought to give a balance for the consistent development of quadcopter activity within the sky. UAVs distribution, execution investigation, way arranging, asset assignment, vitality productivity require more inquire about endeavors. Routine areas such as optimization hypothesis, amusement hypothesis, and transport hypothesis can give methods to get passed some difficulties.

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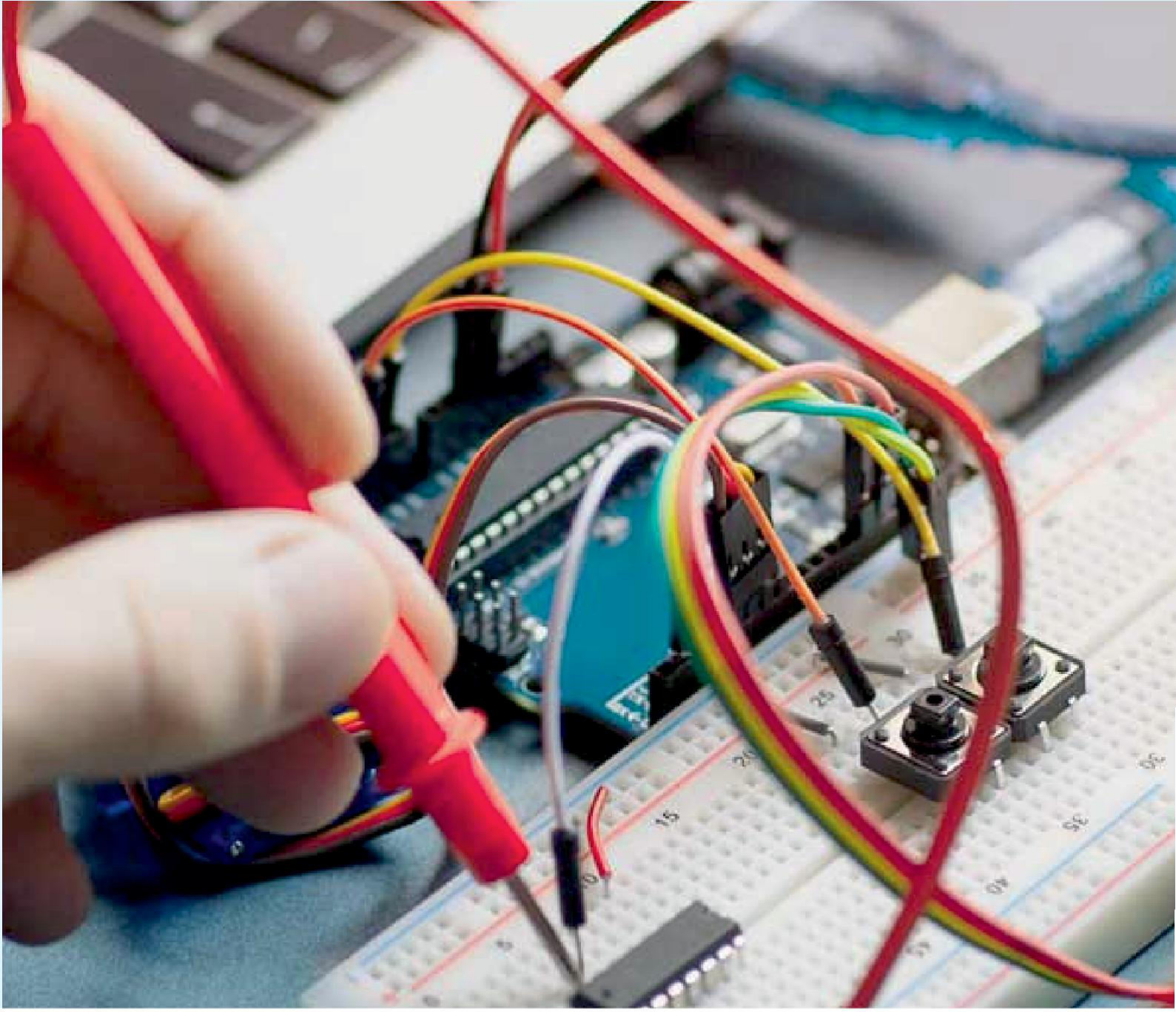

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