Remote Sensing Essentials
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Lecture-12
Unmanned Aerial Vehicle/Drone

Hello everyone and welcome to the new topic which we are going to discuss today that is unmanned aerial vehicle. Also in short we call UAB and also most popularly known nowadays is drone. So, how remote sensing can be done. Of course, these are the vehicles for remote sensing, but nowadays for various purposes they are also being used even for putting insecticides or pesticides in the agricultural fields.

But we are not going to discuss those things, what we will be focusing mainly on the how in the field of remote sensing these platforms can be used as you can see that there are variety of drones now are being used especially one has to focus on the payload.

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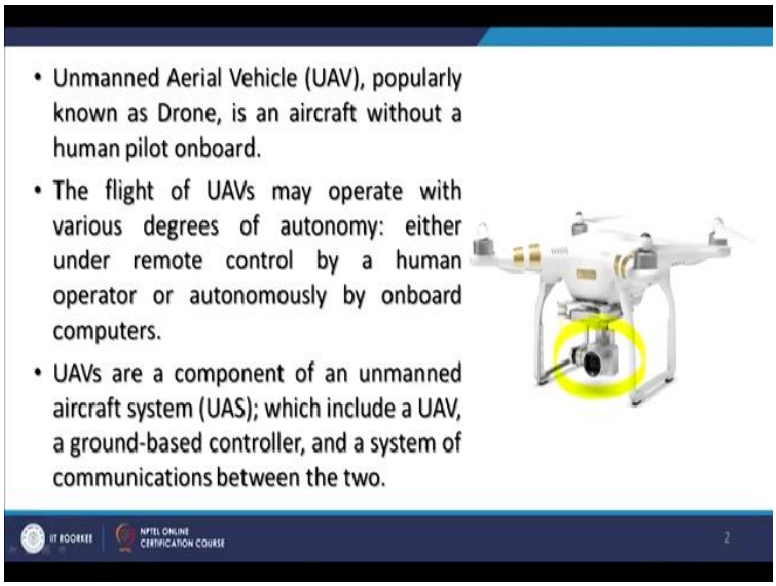

What type of camera it is having. So, basically the advantage with these drones that they have become quite similar to handle and the other big advantage is with them is they are very stable as a you know propeller number of propellers are more like in this example there are 4, so they

remain quite stable in this space and better photography or remote sensing can be done. Of course, the other advantages are like you know, these are unmanned.

So, no pilot is there on the vehicle itself, but a pilot is on the ground. So, these are very lightweight come relatively and also these are also nowadays it could be GPS or GNSS receivers. So, they can be also controlled through control stations or they can be programmed so to do the automatic survive implying this GNSS technology. So, all kinds of technology integrations are happening with nowadays with UAV.

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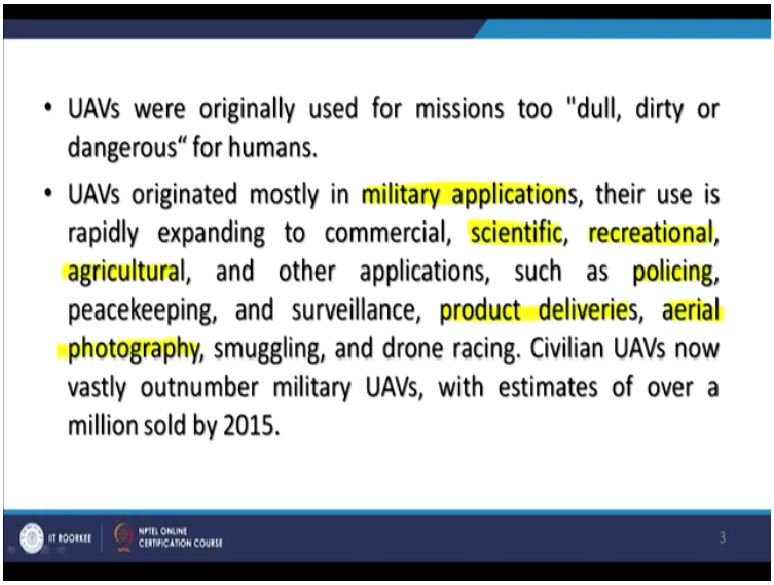

UAV basically they are originally used for missions that we are dull, dirty or dangerous for humans, still these are being used and these drones are also being used extensively in military applications even they are being used and in this one they are loaded with some size and plan and then they execute this thing. There are commercial applications are also there and many people apart from scientific applications, recreational applications are also there.

I have just briefly mention also agricultural applications. Nowadays for crowd monitoring or policing also, it is being used for peacekeeping surveillance and even they are being used to deliver some products, the product you need to be very heavy because these cannot carry very heavy load, but now, slowly powerful UAVs are also coming drones and what we would like to focus mainly on these aerial photography are remote sensing.

There are some other recreational things like drone racing and other things are there. So the civilian because they are relatively not very cheap, not very expensive, and even people can buy online. So that is why they are now outnumber the military UAVs the civilian UAVs and there are millions sold by 2015. So a lot of applications of UAVs are coming.

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As you know that when we did not have the current modern day technology. But the concept of UAV was already there unmanned aerial vehicle in 1918 these were tested, in 1936, more improved version also came of U.S Navy earlier also was U.S Army and then in Vietnam war which was fought by US for a very long time about 30 years, they have used these firebees which we are again UAV.

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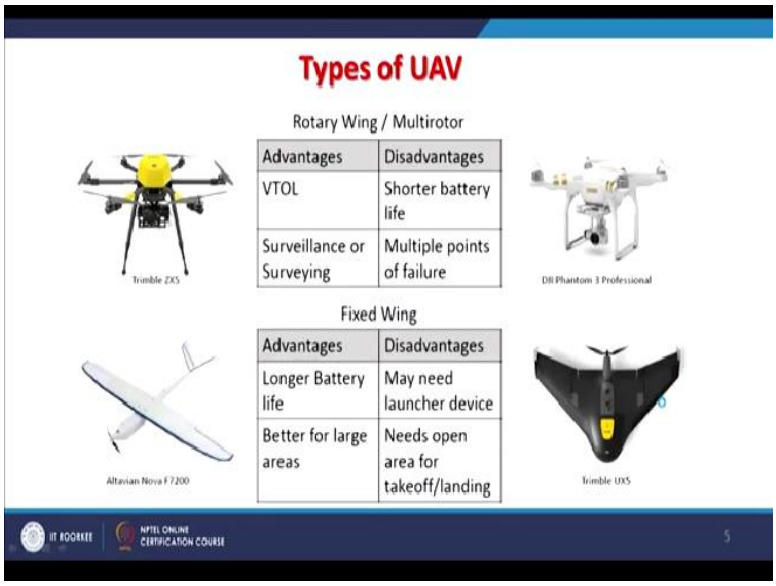

But the most modern one, the current one which are very light weight and very robust and it is very stable also. So, they are having either rotary wings or multi rotor are there are propeller. And of course, the advantages are that they are stable, disadvantage the battery life is a problem because all these motors have to run on batteries, sometimes, the loss of controls are also there. So, when you are having rotary wings these are the advantages and disadvantages.

But advantages in rotary wings that they can be used for surveillance or surveying also for remote sensing. Whereas the fixed being which are given here fixed being like this one, this one they generally have longer battery life, but they require to be launched fixed driving also better for large areas coverage and needs to open area for takeoff and landing. So, there are limitations are there and most popular nowadays are the rotary ribbing or multi rotor UAVS are there.

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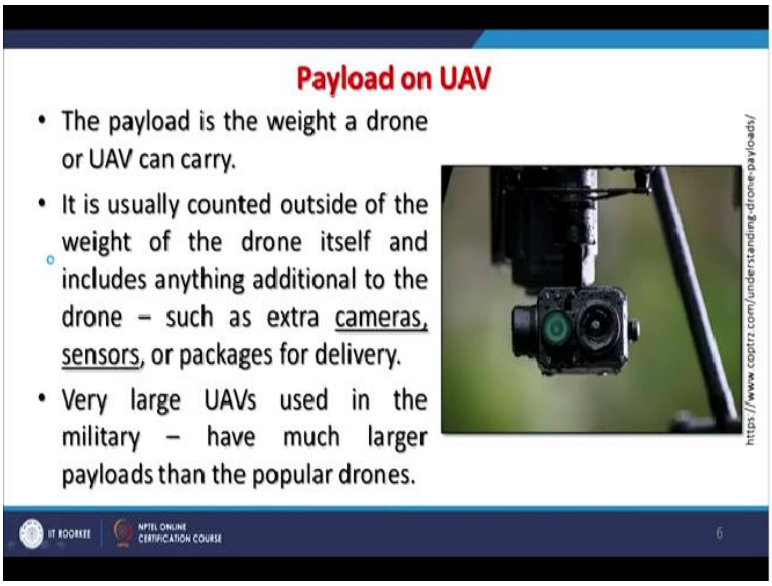

Now payload on UAV that is the main important thing that what kind of camera or sensor which has to be installed with that one that is very important. That payload basically is the weight drone or UAV can carry and it is it is usually counted outside the weight of the drone. So, if drone is having weight say 1 kg then if you are having sensors then that is additional load. So, one has to know exactly the capacity of UAV how much payload it can carry and accordingly the sensors or cameras are installed with the UAV.

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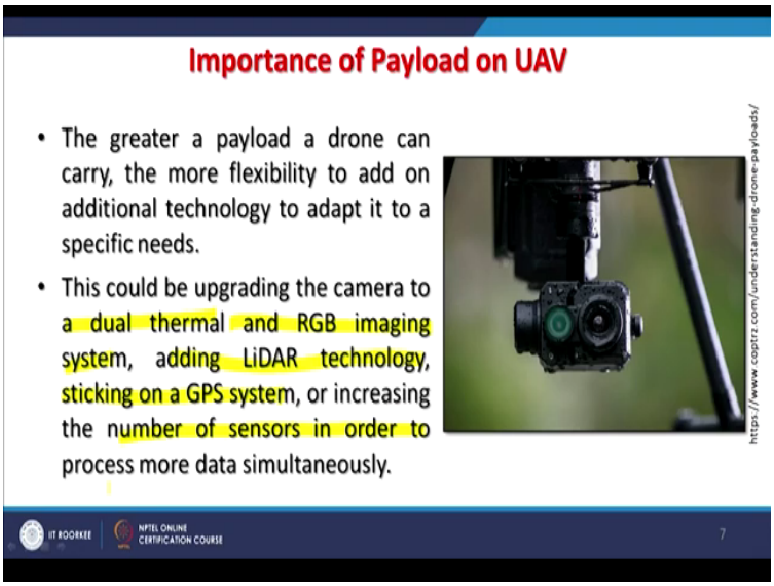

And greater payload of UAVs are being also thought to carry multi sensors greater payload and that is also now being becoming popular and there are also like a you know camera to a dual

thermal and RGB imaging systems very common nowadays, also people are experimenting with LiDAR technology because the biggest advantage as I have said these are very stable platforms.

So they can use by for the LiDAR technology and of course, they are having the GPS system or GNSS system inbuilt. So, they can be controlled or planned the you know the surveys can be planned very precisely accurately and these a number of sensors are now increasing the possibilities of using UAVs are becoming much larger.

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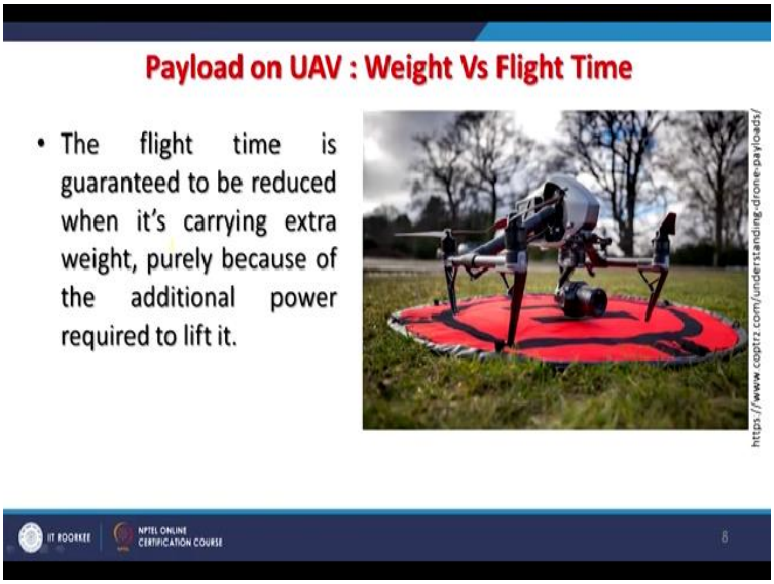

And this is a one of the examples of little bigger UAV and that is also here that weight versus flight time. So, if you go for a heavy payload, because of battery will be consumed lot, so, the flight time maybe less. So, you say sort of inverse relation. So, flight time is guaranteed to be reduced when carrying extra weight purely because of the additional power required to lift it and that so it judiciously it has to be assessed and that how much time is required to cover a part of terrain, how much payload is and what is the battery backup.

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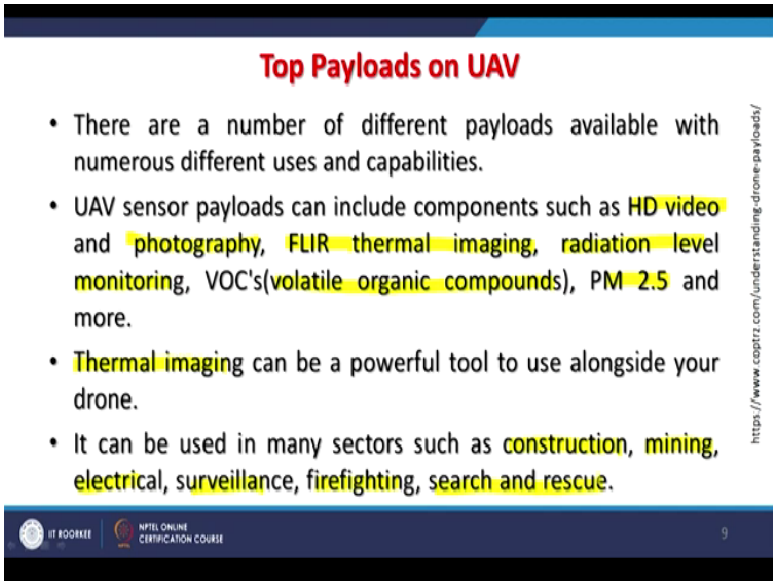

So, all these things have to be assessed before such surveys are initiated. There are a number of different types of payloads available nowadays for different purposes for different applications and with different capabilities. So, UAV sensor payload can include such as high definition video, photography very common payload on UAV, which are being used for various purposes and thermally imaging which is again very important, especially in case of disasters and others.

And like an earthquake or others and one if there are human which are trapped in the rubble of the buildings, then probably these thermal sensors on board of UAV it can help to a large extent also these UAVs can be used to monitor the radiation level, because going in areas where radiation may be very high may be dangerous for human, but such machines can be sent for those surveys. Also volatile organic compounds also this particulate matter of 2.5 and more.

So, where human is not safe UAVs can also be used depending on the requirements. Thermal imaging as I have just mentioned is becoming very powerful tool along with this UAV are drones and it can be used by many other sectors like construction, mining, electrical surveillance, firefighting, search and rescue. So, lot of applications of UAVs are in natural disasters and rescue operations also.

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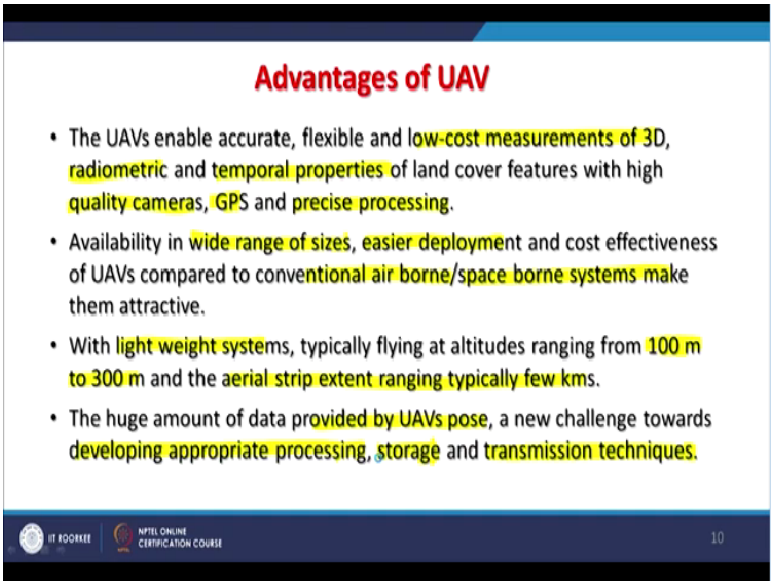

Advantages first few advantages we have already discussed nonetheless UAVs are accurate because they are having GNSS controls or signals receivers, they are flexible means payload can be changed, and the surgery heights can also be changed and the relatively low cost for measurement of 3D 3 dimensional mapping, also radiometric and temporal properties. Temporal properties here that in many times in a day in area can be survived.

So much higher than our normal remote sensing to cover you know different types of features on the ground or different happenings and the only requirement is quality cameras, payloads, GPS and precise processing. This part I would like to emphasize more here because these are providing a lot of data huge data is coming through UAV based service and the processing required very special software's not the standard one.

And georeferencing sometimes also becomes challenging. So, because many times these things are recorded in the video form in digital video or high definition videos, and then rest of the processing is done to develop certain products, maybe a land use map or maybe a digital elevation model for other things. So that is why the processing, intense processing is there. And a lot of challenges are still there.

And in the other advantage with UAVs is there they are available in the by ranges size and shapes number of you know rotating motors and maybe 4 6 10 depending for what purpose and

how much stability is required. Their deployment is of course very easy, cost effectiveness we have already discussed, which is definitely better compared to conventional airborne or the space borne systems that is why these are becoming more popular, more attractive for in order to cover a small area.

But if one would like to cover a large area, then probably UAVs are not a fit for those kind of tasks. They are also light weight systems relatively and the height typically they can fly between under 100 to 300 meters and accordingly depending on the height, the aerial is stripped or footpath extend will also very typically do few kilometres, huge amount of data is provided by the UAV which I have already said and therefore challenges towards developing appropriate processing.

Storage is also very much required and transmission techniques, transmission techniques because each UAV or payload which is doing the survey need to record and sometimes need to transmit the data through a direct broadcasting to the receiver. So, if enough is storage is not there then transmission might be required. And sometimes in real time now on a TV monitor, one would like to see what the UAV or the payload is surveying.

So, the near real time or real time transmission is also required. So, becomes a necessity in certain kind of UAV based remote sensing, storage also very much required for serious UAV based remote sensing. So, that the data later on can be analyzed.

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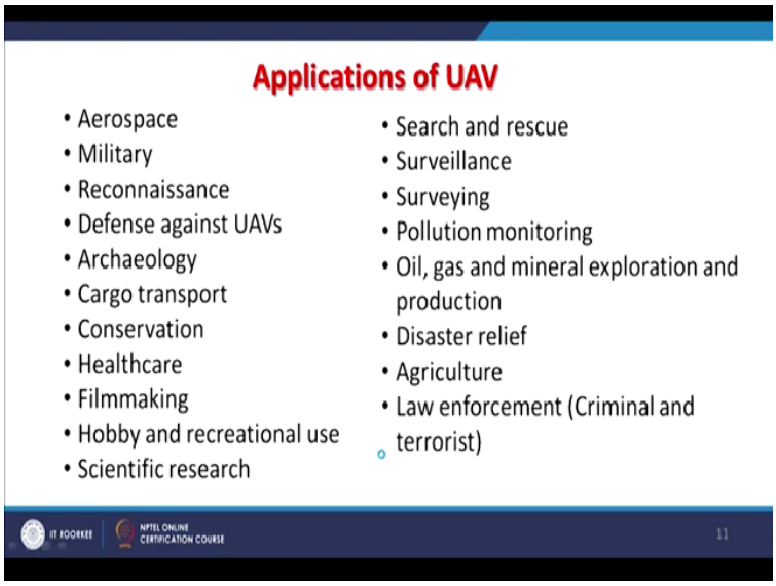

Various applications and this is not exhaustive list and new different type of applications are getting here are getting added almost every day. So, of course, it would be start with the aerospace military, I already told you that this is and they are a military application they are also using very big and which can carry heavy payloads also for reconnaissance survey, they are being used.

Defense against UAVs again UAVs UAVS are put against UAVs. In Archaeological survey, in cargo transport, in consideration, in healthcare, in filmmaking, in videography, and in hobby recreational use, lot of people are buying a small UAVs for their own hobbies. Of course, scientific research, they are being used UAVs. I also mentioned earlier in natural disaster scenarios, these are being used extensively for search and rescue operations.

For surveillance, for crowd monitoring, that is also being used, serious remote sensing based serving, also being used pollution monitoring, profile doing profiling of say Pm 2.5 or others in the atmosphere that can also be done, oil, gas and mineral explorations and productions. These are being used and of course, disaster relief and relief and rescue operations, agriculture extensively nowadays, these are being used not only for survey, but also spraying insecticides and pesticides.

And to the target are affected plants and police is also extensively have started using these things because if they fly by helicopters they are having helicopters are having limitations compared to UAV and therefore, these can be sold and n number of applications are already there. People are developing more applications as different types of payloads, more efficient payloads with better storage capabilities are becoming available.

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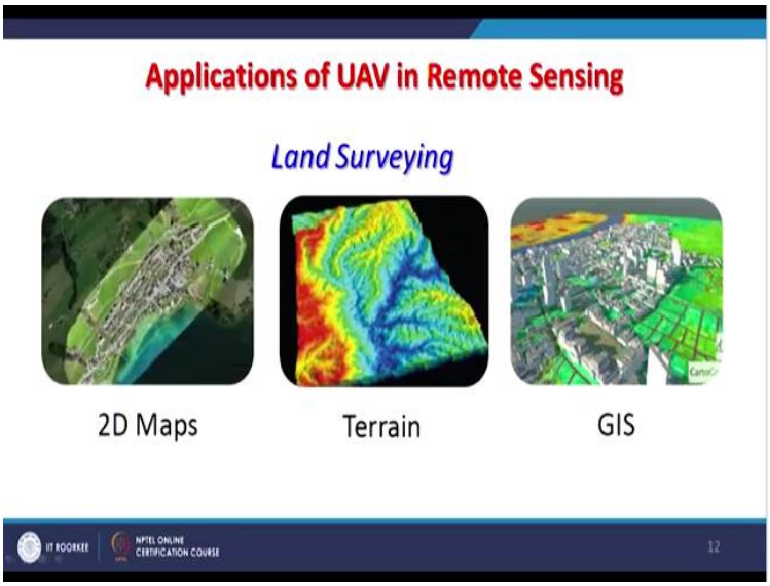

And these are becoming very, very popular and here few examples I can discuss which is directly related with how you UAVs are being used in remote sensing. So, first one is the land surveying of course, 2D maps can be created and the digital elevation models can also be created. These products are from there only. And the GIS or 3D mapping can also be done using UAVs.

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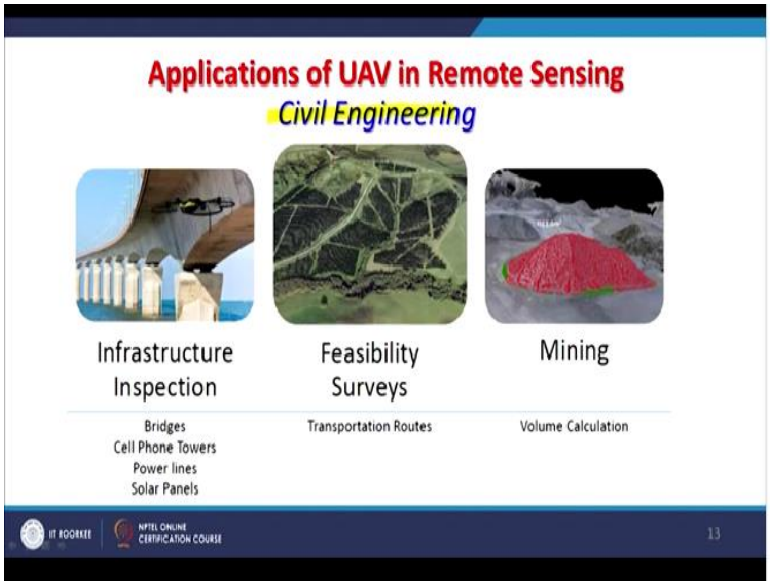

In civil engineering, for infrastructure inspections, a big bridge has come. Now, we would like to inspect how it is performing over or they are in problem. So, it can be used for bridges and cell phone, towers power lines, solar panels is in the picture it is shown that it is being used for bridge and of course the feasibility surveys also maybe for transportation routes or other things.

Railways have also started using for these UAVs for even maintenance or finding out falls on the lines, mining people have also started using for volume calculations and other related operations in the mining industry.

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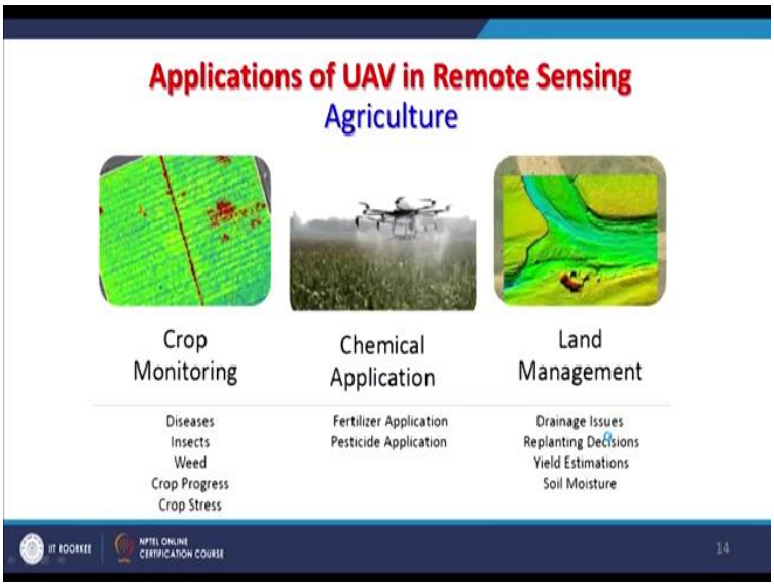

Agriculture applications like crop monitoring, as you can see here that there might be some problem in here in the plant. So, that has been surveyed. Now, targeted pesticides can be put. So, it saves a lot of pesticides and other things it can go there. So crop monitoring disease, insect bead, crop progress, crop stress, all these things can be studied depending on the what type of payloads are put in the surveys.

Chemical applications, fertilizer applications and pesticides applications in large, large agriculture fields where it becomes difficult for human and these UAVs little powerful which can carry a lot of load can be implied land management also these can be used for drainage related issues, replanting decisions, yield estimations, soil moisture, surveys again UAVs are being used.

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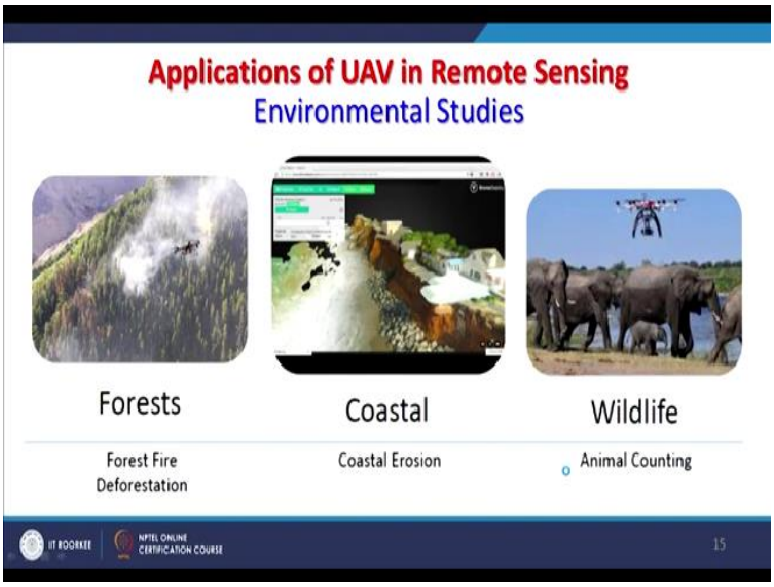

Environmental related studies, forest fires very common in Guatemala of India every year in the month of April, May, June and wind, the moisture or humidity is very less, some are natural, some are manmade forest fires are seen. So, what is the extent of forest fire and even if these UAVs can carry big payloads, then these can also be used to extinguish small size fires. And deforestation is studies can we use coastal area it can be used for to find out the coastal erosion and doing mapping. Wildlife of course, it can be used for animal counting or many kinds of wildlife related activities.

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Humanitarian efforts in the rescue operations in disaster mapping when this Nepal earthquake in 2015, in April 25th occurred and many UAVs were employed for search and rescue operations. And they later on also, these UAVS can be used for post disaster assessment. Hazard monitoring for like in volcanoes, difficult for human but the UAVs can be put on service for glacius, for flood. So in an earthquakes also and landslides and this list we can keep adding.

Emergency to medicines see here medicines are being delivered to a target location. So, another very good advantage of UAVS**,** the UAV is carrying the box, boxes having medicines and these can be delivered, there might be a loss of road connectivity or no other possibility of delivering emergency medicines these can be delivered by UAVS also. So, this brings to end of this discuss unrelated with UAVs.

We have seen various types of UAVs, we have seen or discuss various types of applications associated with UAVs and currently the list is not exhaustive and many, many new applications are being added almost every day. We have also discussed about advantages and disadvantages associated with UAVs. This brings to end of this discussion, thank you very much.